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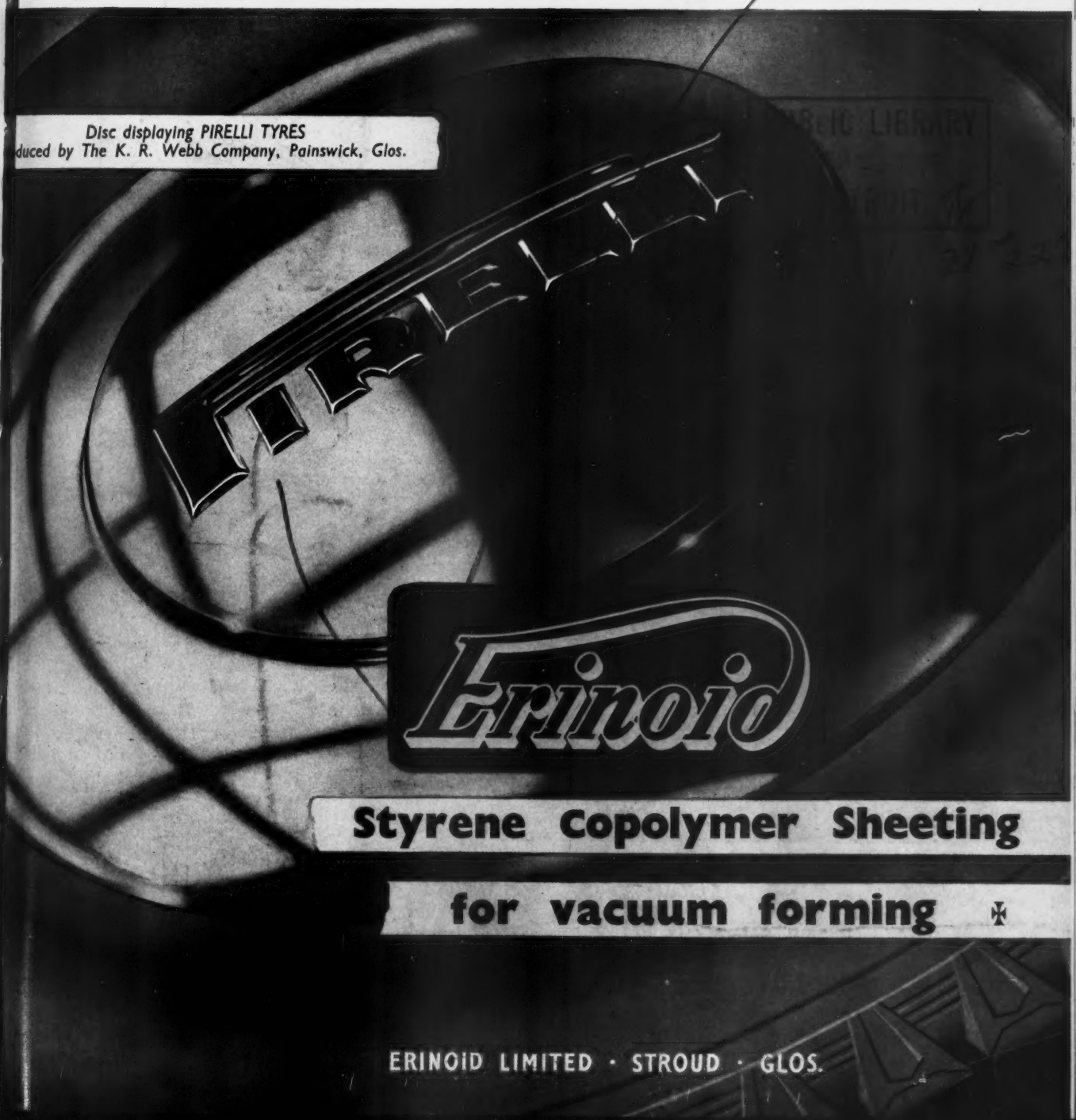
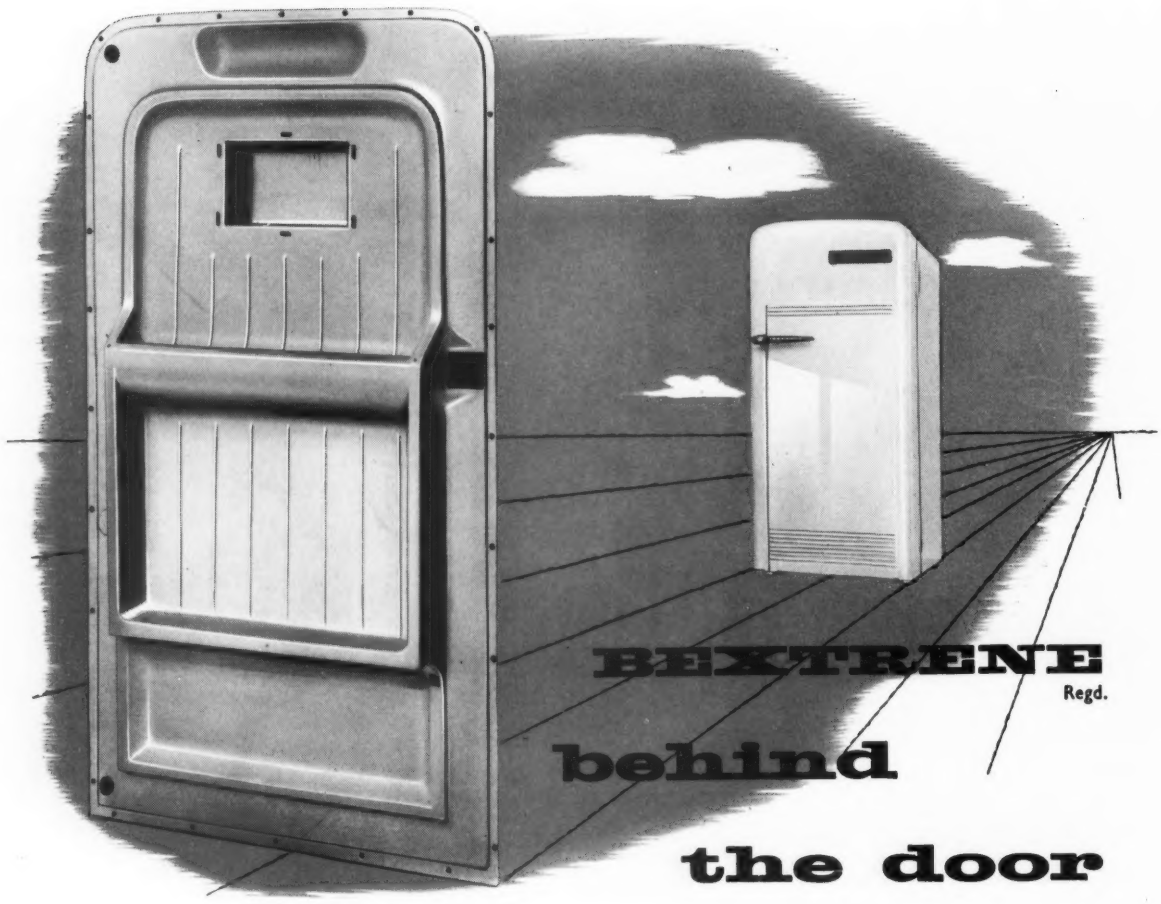


Disc displaying PIRELLI TYRES
duced by The K. R. Webb Company, Painswick, Glos.



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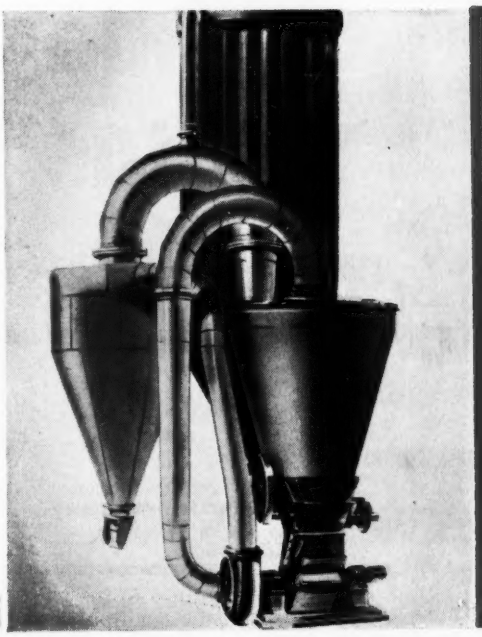

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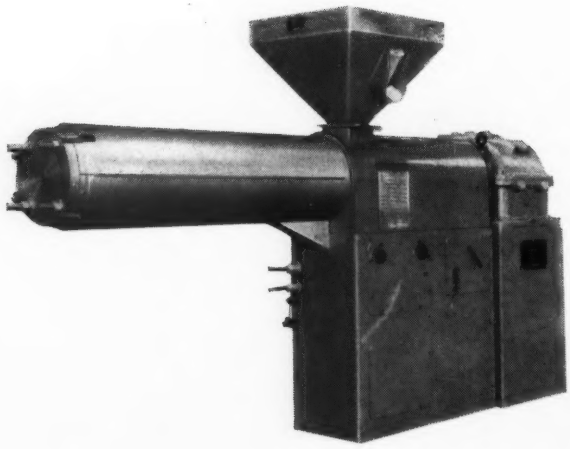

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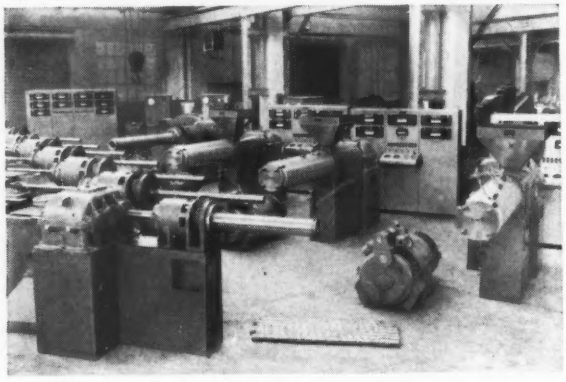

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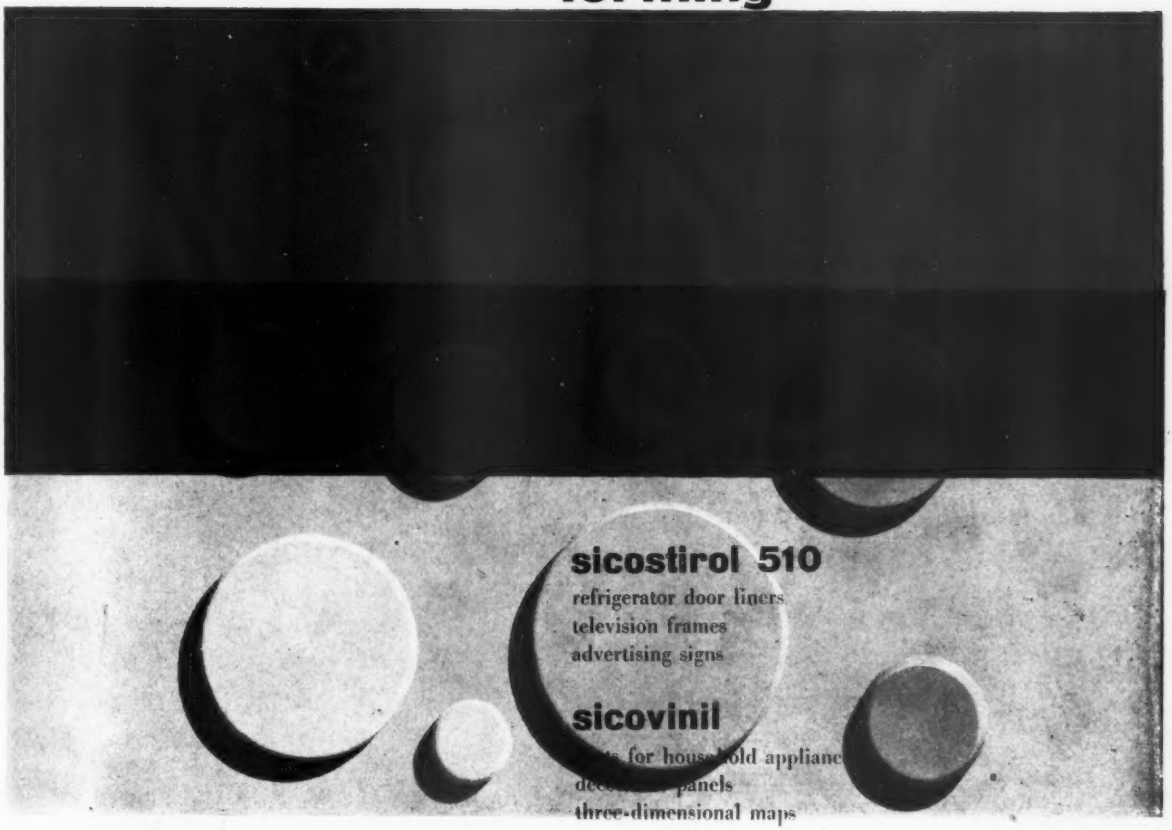

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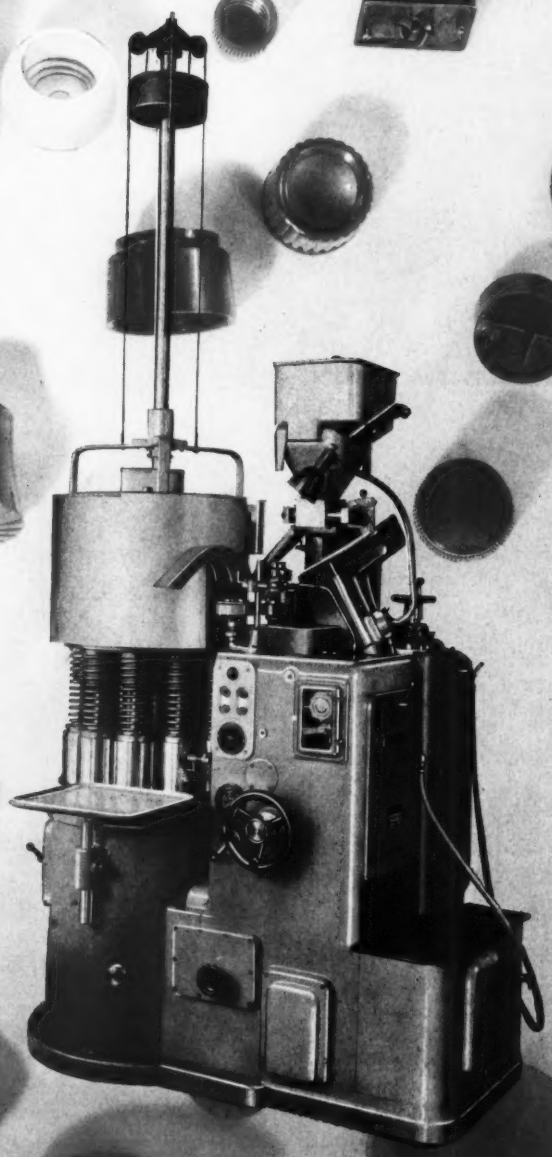

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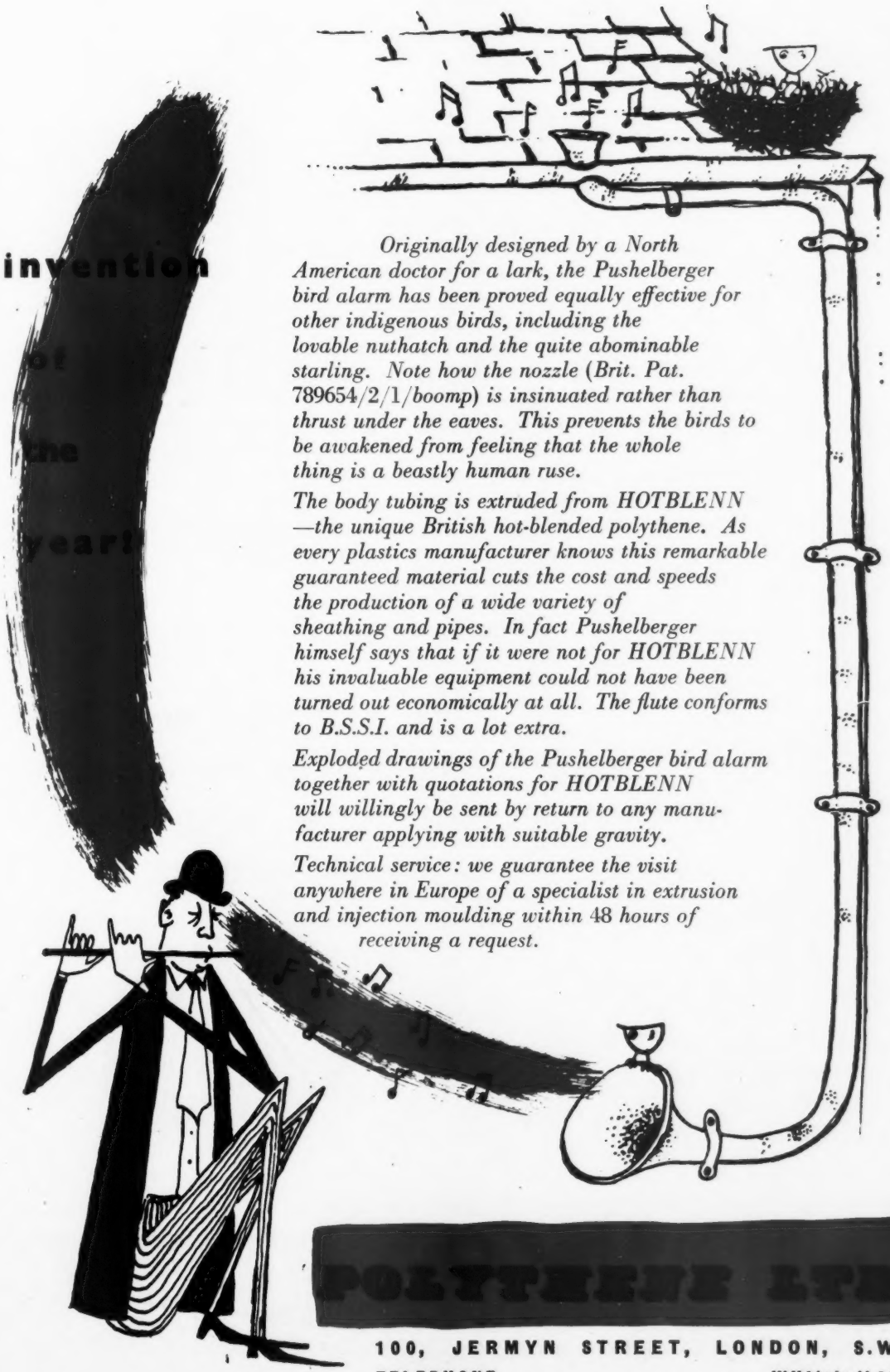

Originally designed by a North American doctor for a lark, the Pushelberger bird alarm has been proved equally effective for other indigenous birds, including the lovable nuthatch and the quite abominable starling. Note how the nozzle (Brit. Pat. 789654/2/1/boomp) is insinuated rather than thrust under the eaves. This prevents the birds to be awakened from feeling that the whole thing is a beastly human ruse.

The body tubing is extruded from HOTBLENN —the unique British hot-blended polythene. As every plastics manufacturer knows this remarkable guaranteed material cuts the cost and speeds the production of a wide variety of sheathing and pipes. In fact Pushelberger himself says that if it were not for HOTBLENN his invaluable equipment could not have been turned out economically at all. The flute conforms to B.S.S.I. and is a lot extra.

Exploded drawings of the Pushelberger bird alarm together with quotations for HOTBLENN will willingly be sent by return to any manufacturer applying with suitable gravity.

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MODEL NUMBER	150-H-6	300-H-12	400-H-20	800-H-48
Capacity (oz.–Single Feed)	6	12	20	48
Capacity (oz.–Double Feed)	8	16	28	64
Material Injected (cu. in. per min.)	440	1035	1330	2895
Plasticizing Capacity (lbs. per hour)	60	100	135	350
Mould Clamp Capacity (tons)	150	300	400	800
Mould Space (hor. × vert.):				
(*a*) Full Platen Vert.	10½″ × 25″	16½″ × 33″	20½″ × 42″	36″ × 54″
(*b*) Full Platen Hor.	20½″ × 15″	30″ × 20″	36″ × 26½″	54″ × 36″
Daylight Opening without Ram Spacer	20″	30″	40″	55″
Daylight Opening with Ram Spacer	16″	26″	34″	47″
Mould Thickness without Ram Spacer	10″	10″	15″	20″
Mould Thickness with Ram Spacer	6″	6″	9″	12″
Clamp Travel (max.)	10″	20″	25″	35″
Motor Horse-power	20	40	50	100
Shipping Weight (pounds)	14500	22000	39000	75000

NOTE: All ratings based on moulding general purpose polystyrene

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Model 600-H-32 Capacity 32 ounces.
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Model Police Launch Vacuum-formed from **Vitrone** *Rigid Vinyl Sheeting reproduced by courtesy of Sebel Products Ltd.*

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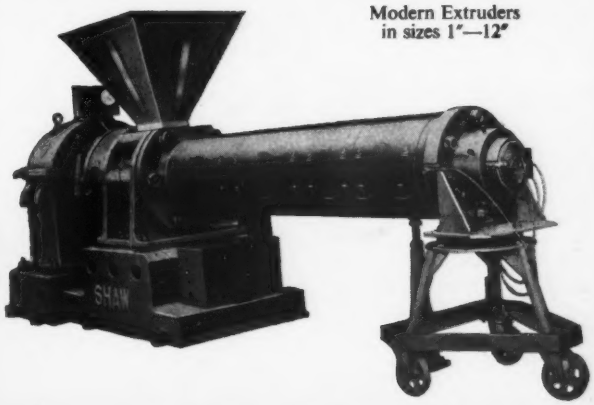

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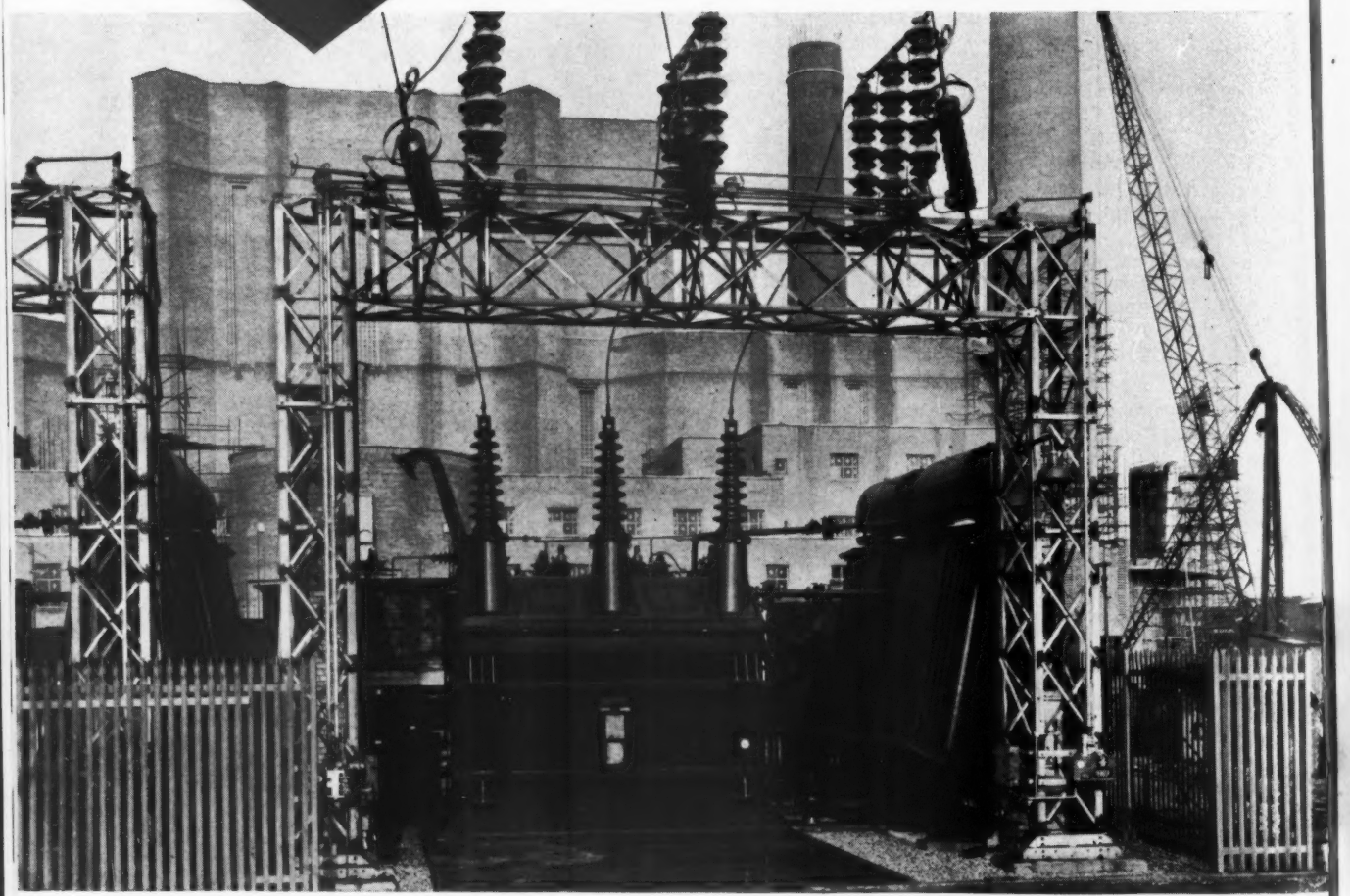

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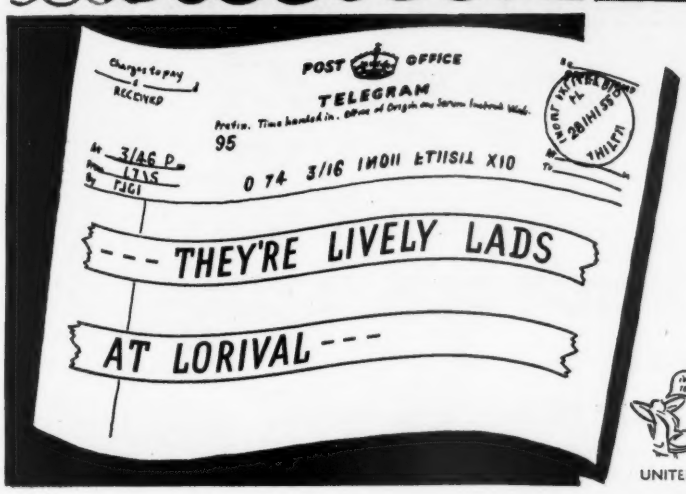

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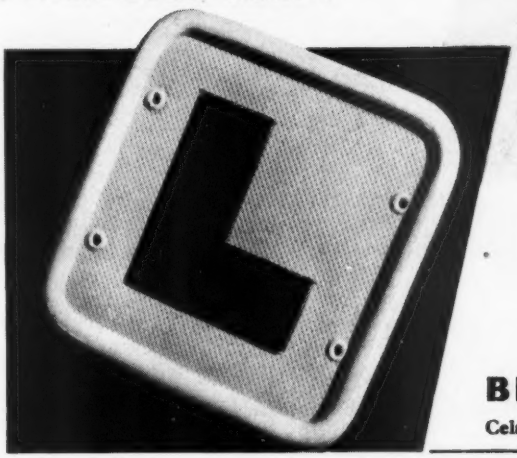

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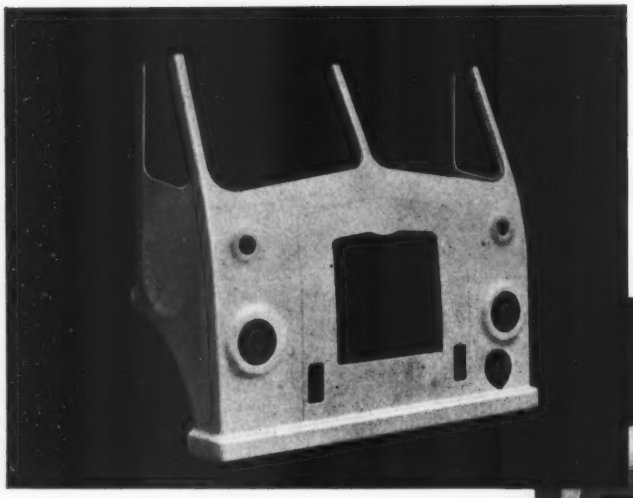
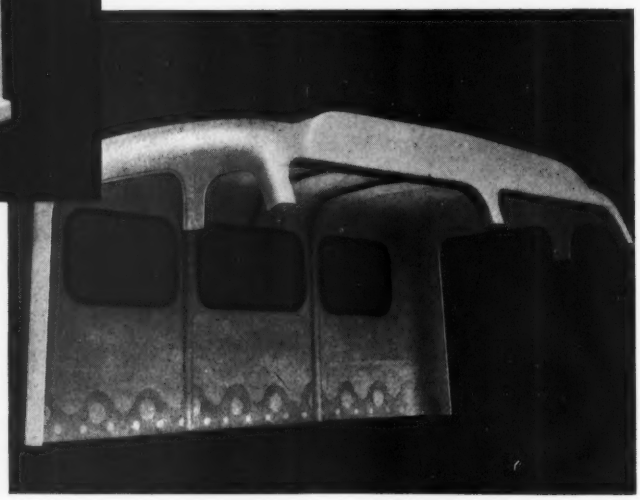
Bristol Build with Structural Mouldings

to speed and simplify production



Of the two basic parts for the Bristol Cab, the front is moulded in one piece, to which the roof member is afterwards jointed. The conventional framework is entirely dispensed with and all strengthening ribs are moulded in.



The roof section. The roof pan is indented for tarpaulin stowage and is strong enough to withstand continuous punishment by drivers jumping down from the load. A detail point; glass roving impregnated with "Beetle" polyester resin is used to partially fill the joint between the two mouldings.

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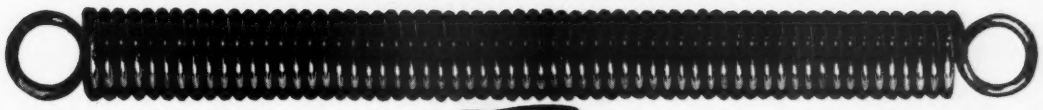
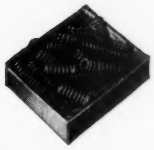
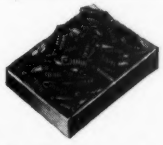


No. 760. 3 doz. Assorted Light Compression Springs 1″ to 4″ long, 22 to 18 S.W.G., ¼″ to ½″ diam. 6/6 each.



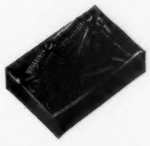
No. 98A. 3 doz. Assorted 1″ to 4″ long, ¼″ to ¾″ diam., 19G to 15G. 5/6 each.

No. 757. Extra Light Compression, 1 gross assorted, ⅛″ to ¾″, ¼″ to 2″ long, 27 to 20 S.W.G. 15/- each.



No. 388. ¼ gross Assorted Small Expansion Springs. ½″ to 1½″, 18G to 21G. 9/6 each.

No. 758. Fine Expansion Springs. 1 gross Assorted ⅛″ to ¾″, ¼″ to 2″ long, 27 to 20 S.W.G. 15/- each.



No. 466. ¼ gross Assorted Small Expansion Springs ⅜″ to 1½″ long, 3/32″ to 3/16″ diam., 21G to 24G. 6/6 each.

No. 1013. 1 gross Small Coil Compression Springs, ⅜″ to 1¼″ long, 3/32″ to 7/16″ diam., 24G to 19G. 6/- each.

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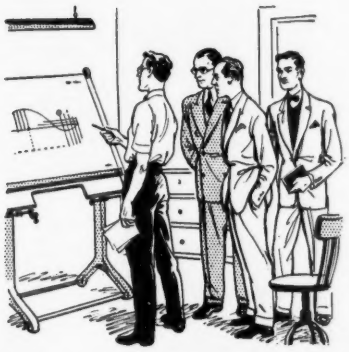

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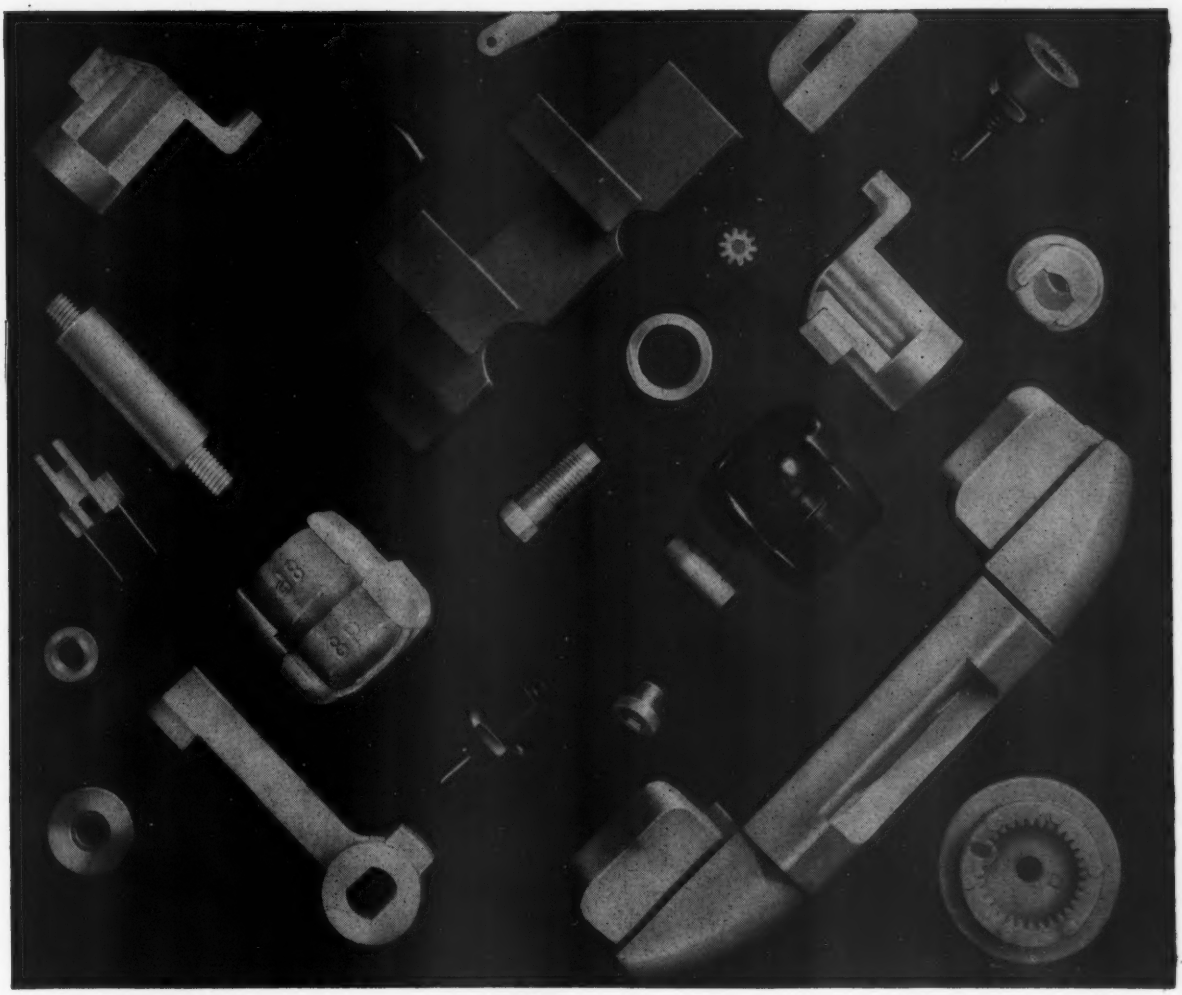
We shall be glad to have your enquiries regarding NYLON moulding for *your* industry. Everything under one roof — Design Unit, Drawing Office, Tool Room and large Moulding Shop — completely at your disposal.



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CRC 277

W.W.B. designed the Tools and produced the cabinet and accessories for this "Regentone" Portable

A typical example of the various operations carried out in the W.W.B. factory at Billericay, Essex. The Cabinet is in Red Phenolic . . . the accessories . . . Bezel in clear polystyrene . . . Socket and Plug in Black Phenolic . . . Extension Spindle in Polystyrene . . . Control Knob in Red Phenolic . . . Volume Knob, In-Out Switch, and M.W.-L.W. Switches in Cream Polystyrene . . . Gold Spray-Lining Colour Blocking-Lettering.

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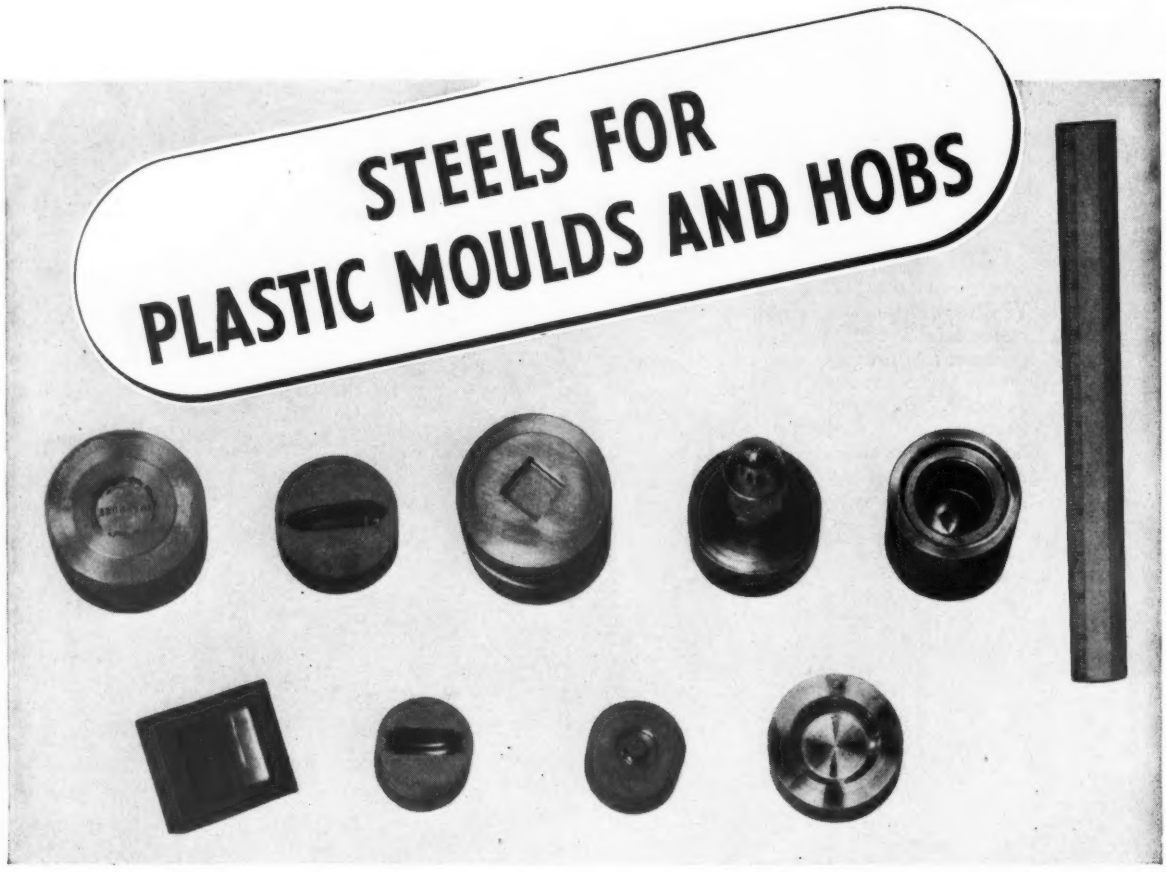

The six Edgar Allen steels listed below cover the complete requirements of the plastics industry for the manufacture of moulds and hobs and have been developed from extensive research in conjunction with famous plastics manufacturers.

Double Six Master Hob Steel
Edgar Allen's Plastic Hobbing Steel
Imperial Stainless Mould Steel
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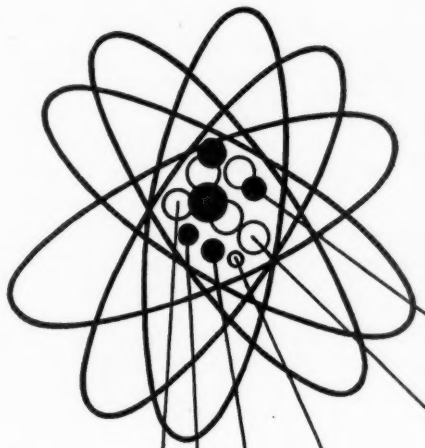
U·M·P

For Tubes and Plastics



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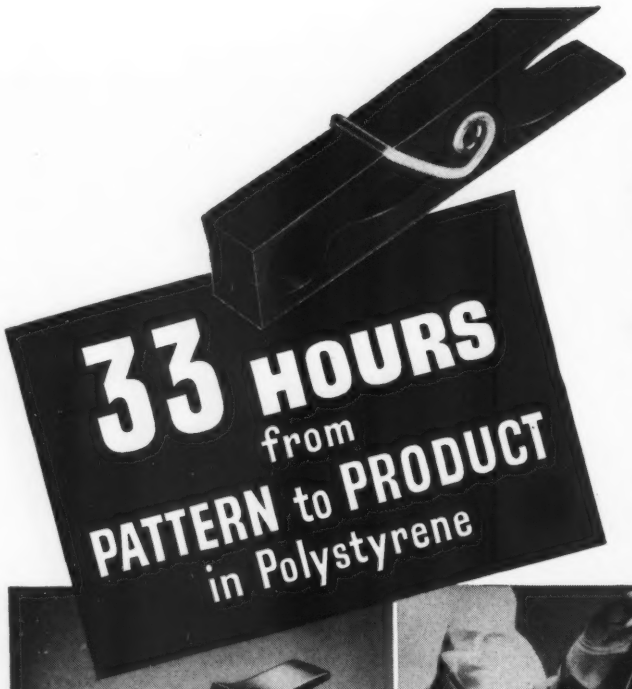

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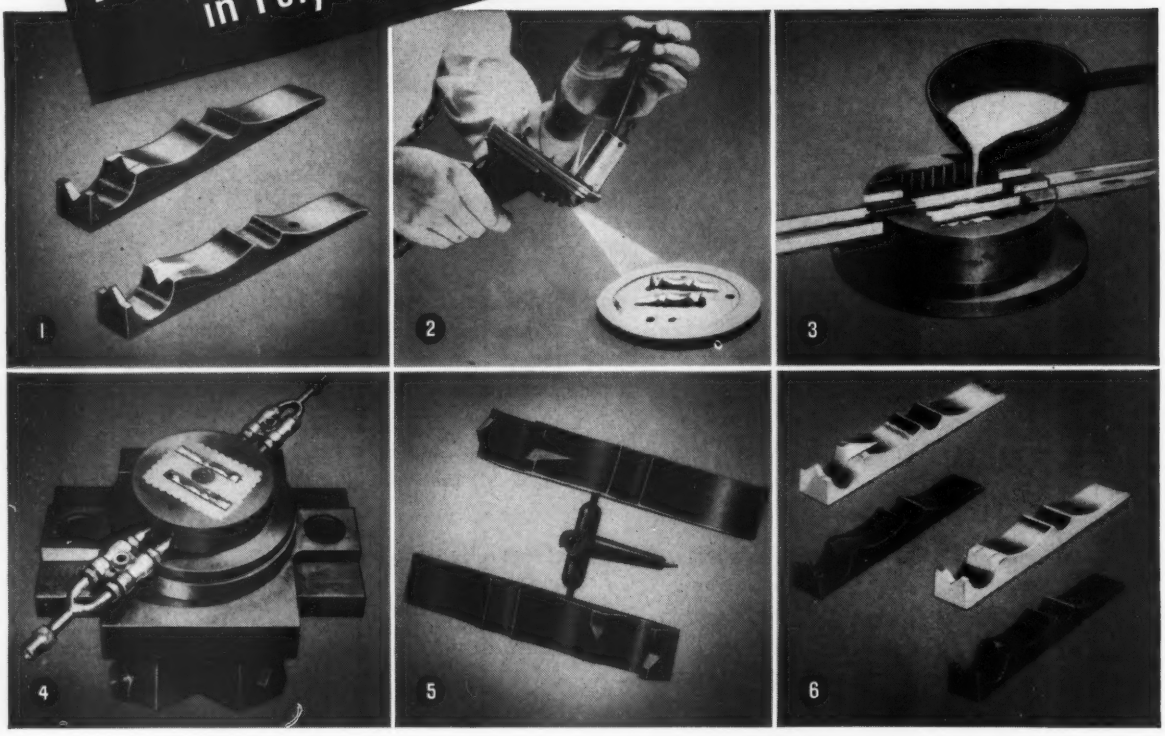
By courtesy of Messrs. S. Smith & Sons (England) Limited, we illustrate manufacture of injection mould for production in Polystyrene in a total time of 33 hours and a fraction of cost of machining.



1. Aluminium master pattern.
2. Spraying pattern with Cerrocast.
3. Pouring molten Cerrocast to back sprayed shell and embed water cooling tubes.
4. Complete mould. 5. Typical shot.
6. Comparison of patterns and mouldings.

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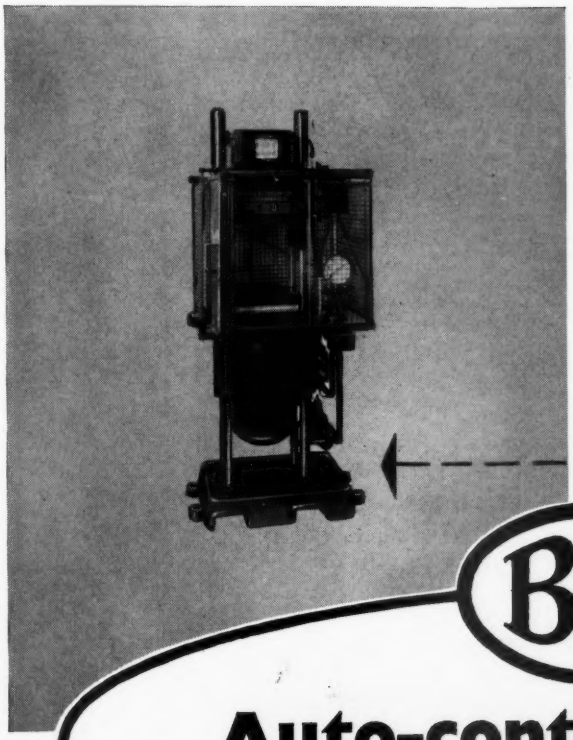

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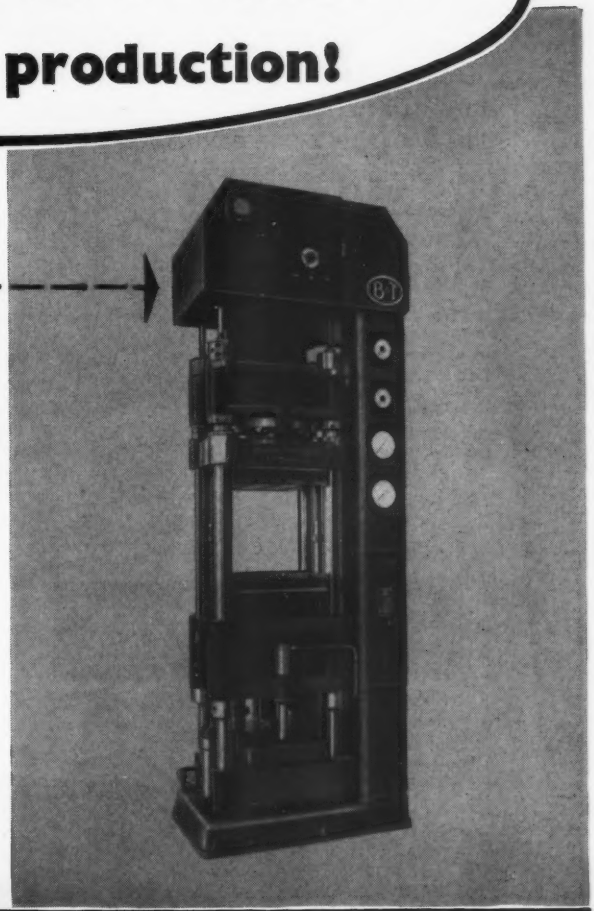

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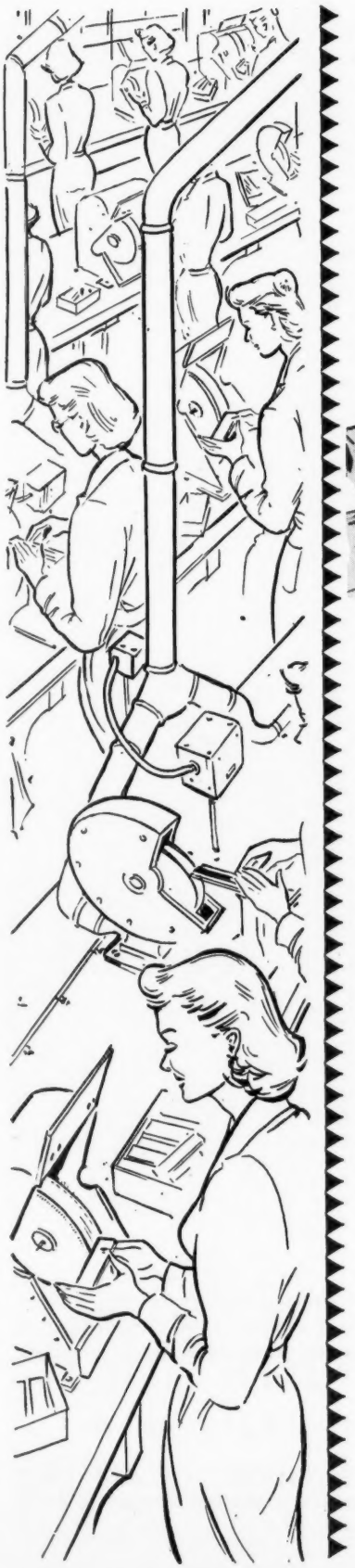

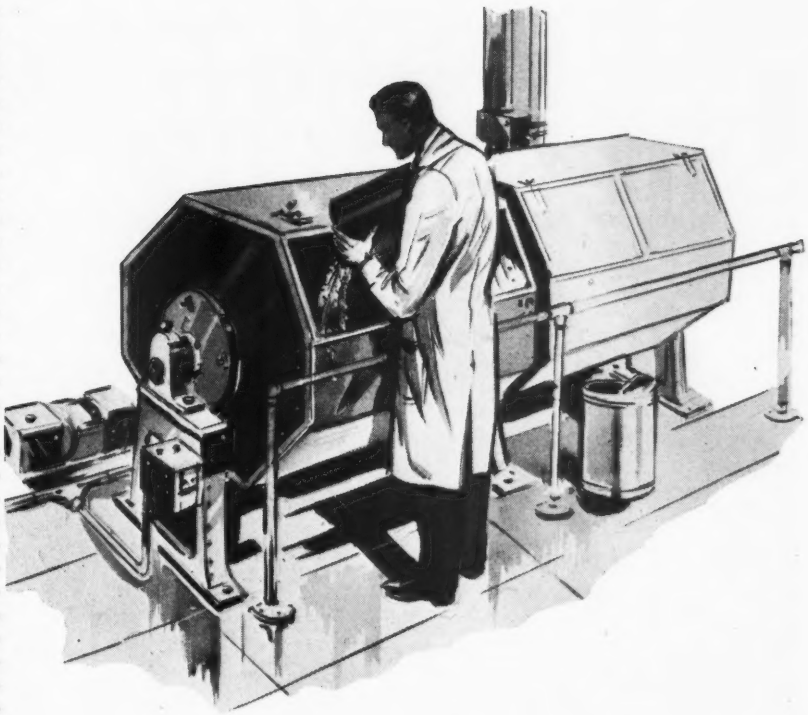

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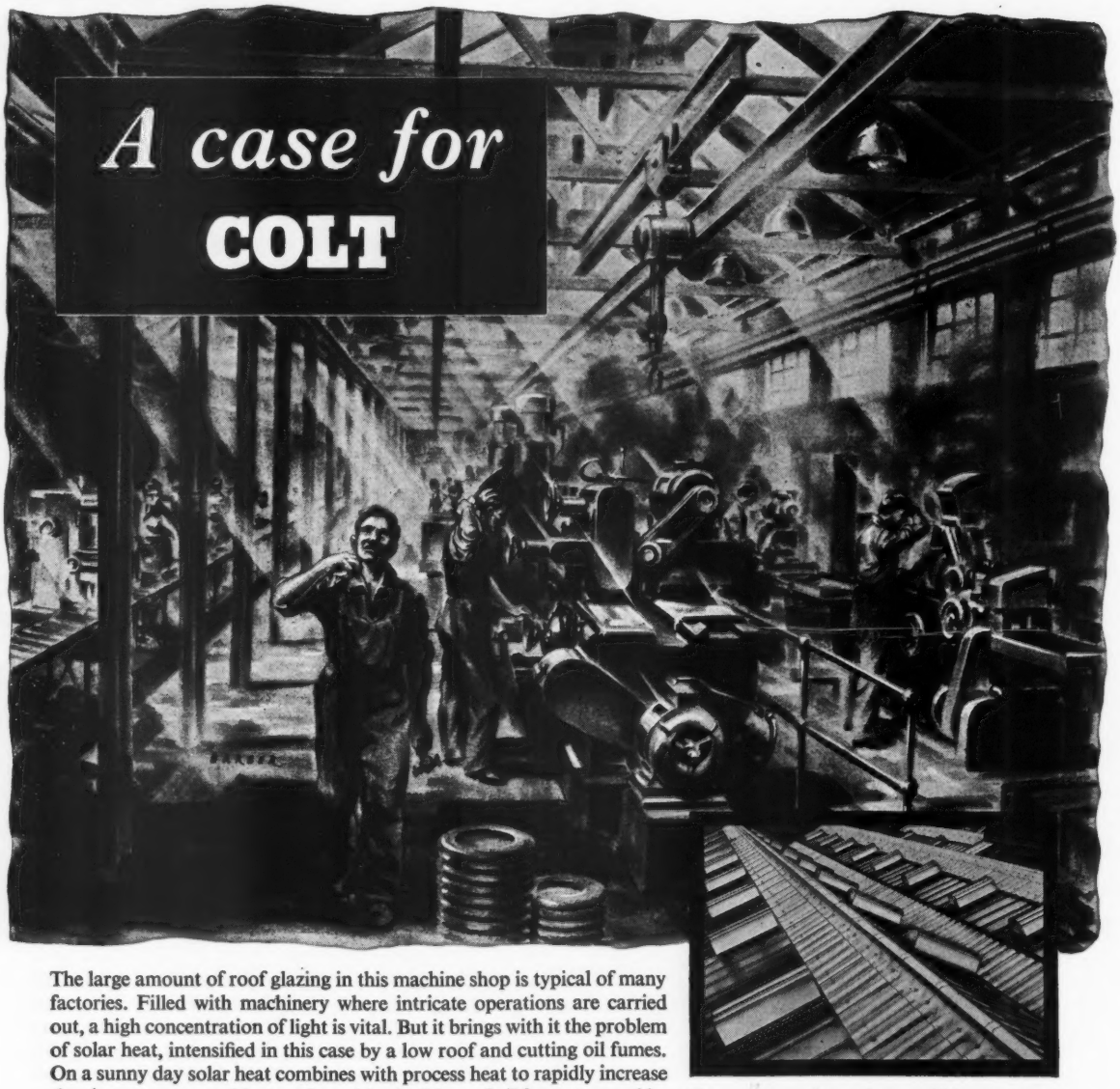

The large amount of roof glazing in this machine shop is typical of many factories. Filled with machinery where intricate operations are carried out, a high concentration of light is vital. But it brings with it the problem of solar heat, intensified in this case by a low roof and cutting oil fumes. On a sunny day solar heat combines with process heat to rapidly increase the air temperature; this, together with a build up of oil fumes trapped by the low roof, inevitably results in falling output and an increase in human errors and accidents. This is a typical case, calling for Colt Ventilation, and one that we have often met and overcome in our dealing with 9,000 major industrial and commercial organisations.

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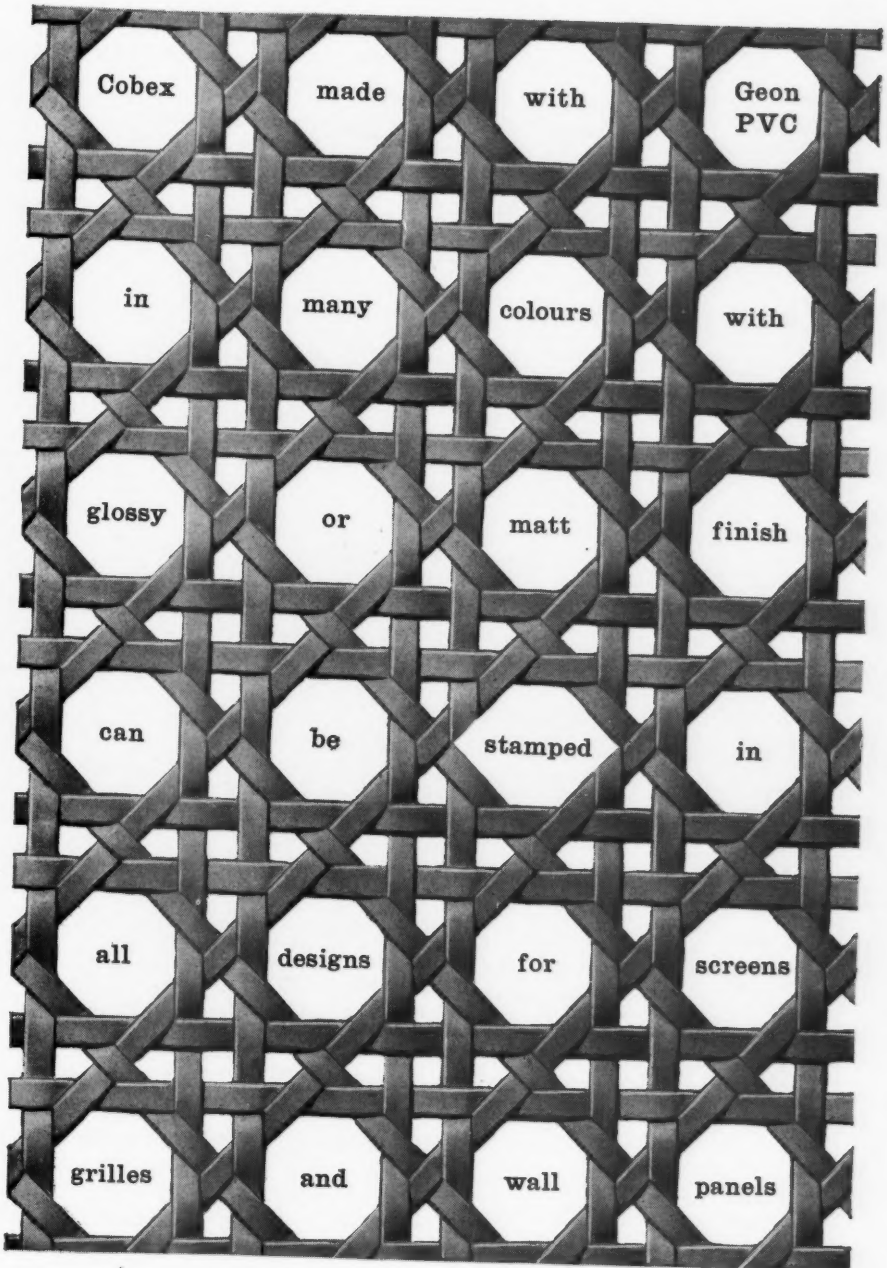
G.104

Reading between lines made with GEON PVC


Cobex made with Geon PVC
in many colours with
glossy or matt finish
can be stamped in
all designs for screens
grilles and wall panels

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Cobex rigid vinyl sheet made with Geon PVC perforated by G. A. Harvey & Co. (London) Ltd.

Geon
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'Geon' is a regd. trade mark

For further information about Geon PVC please write for descriptive booklet No. 51 free on request.

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. . . that patterns and templates made with synthetic resins effect extensive savings in costly materials and allow rapid design modifications.

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The advantages listed are not merely general claims, but have been taken from the factory records of one of the largest aircraft manufacturers in the world.
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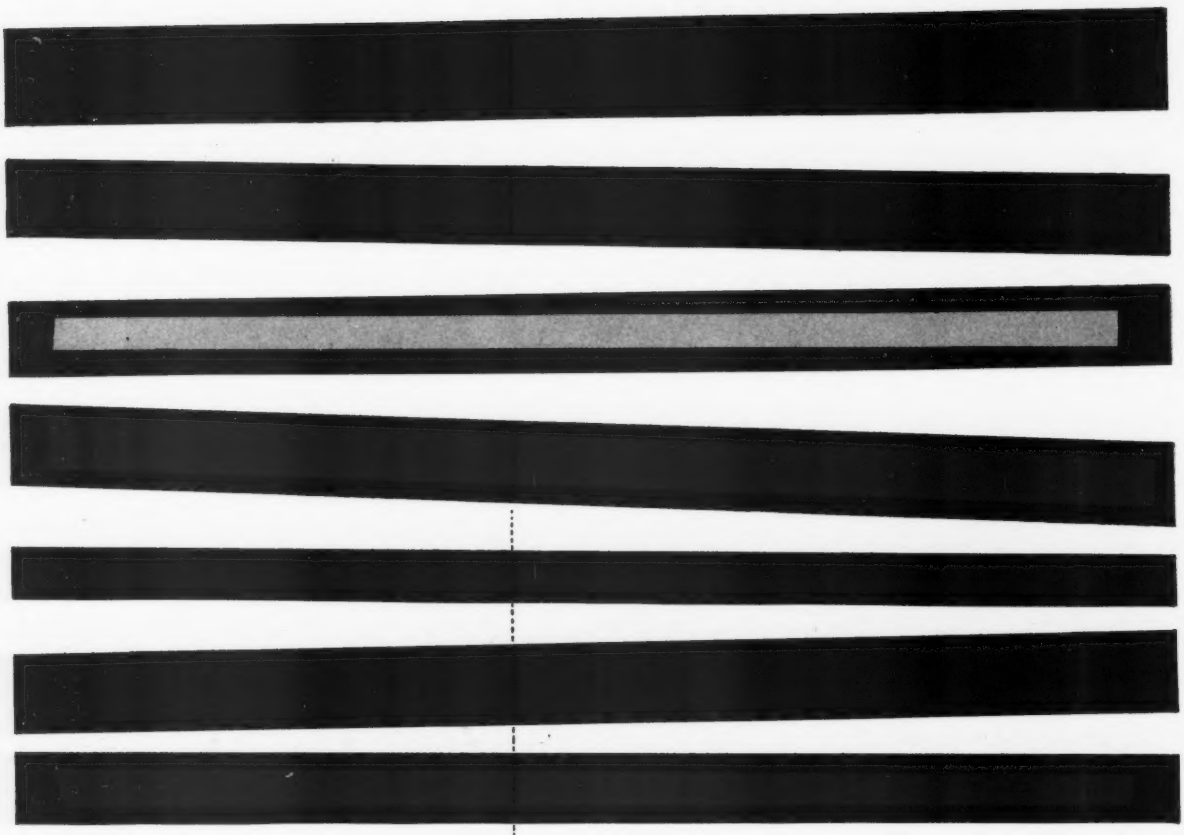

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Polymon Blue 3R
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do not migrate
(and so do not cause contact bleed or colour bloom in the plastic)

specially designed for colouring polythene and polystyrene

Polymon colours

* are heat-stable
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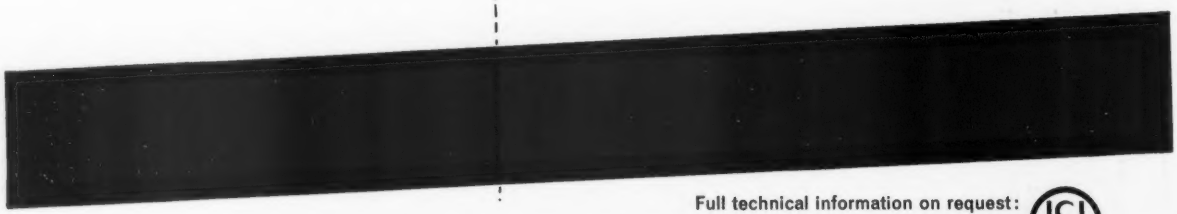

Full technical information on request:

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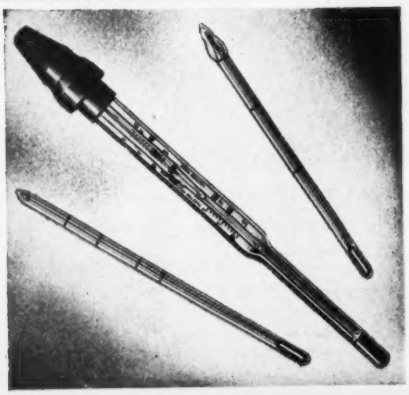

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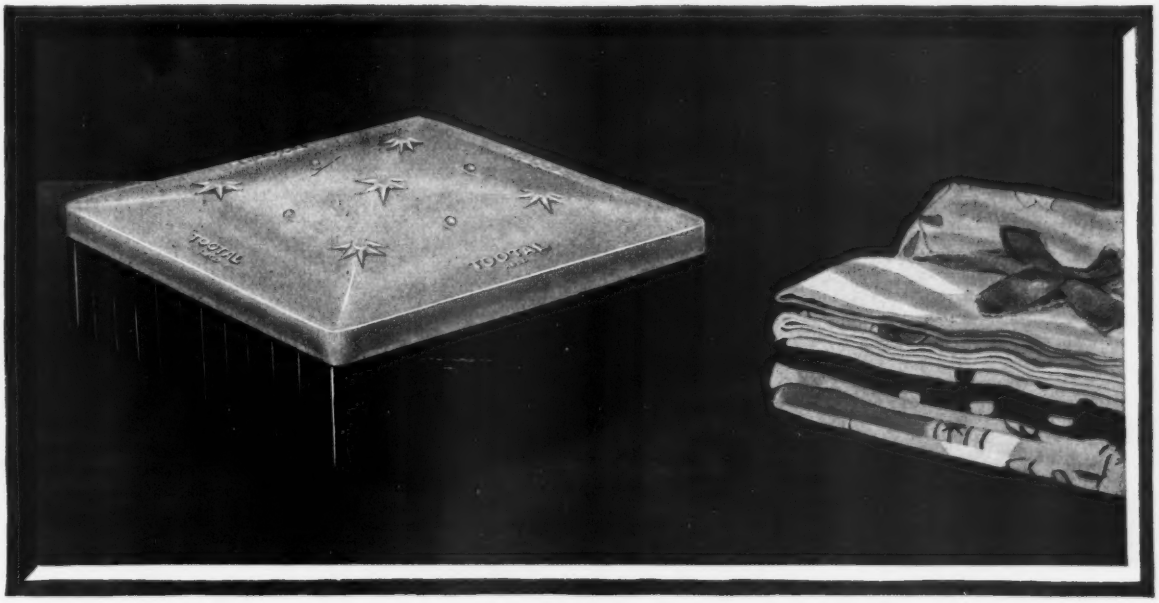

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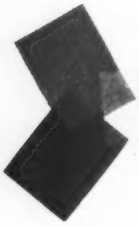

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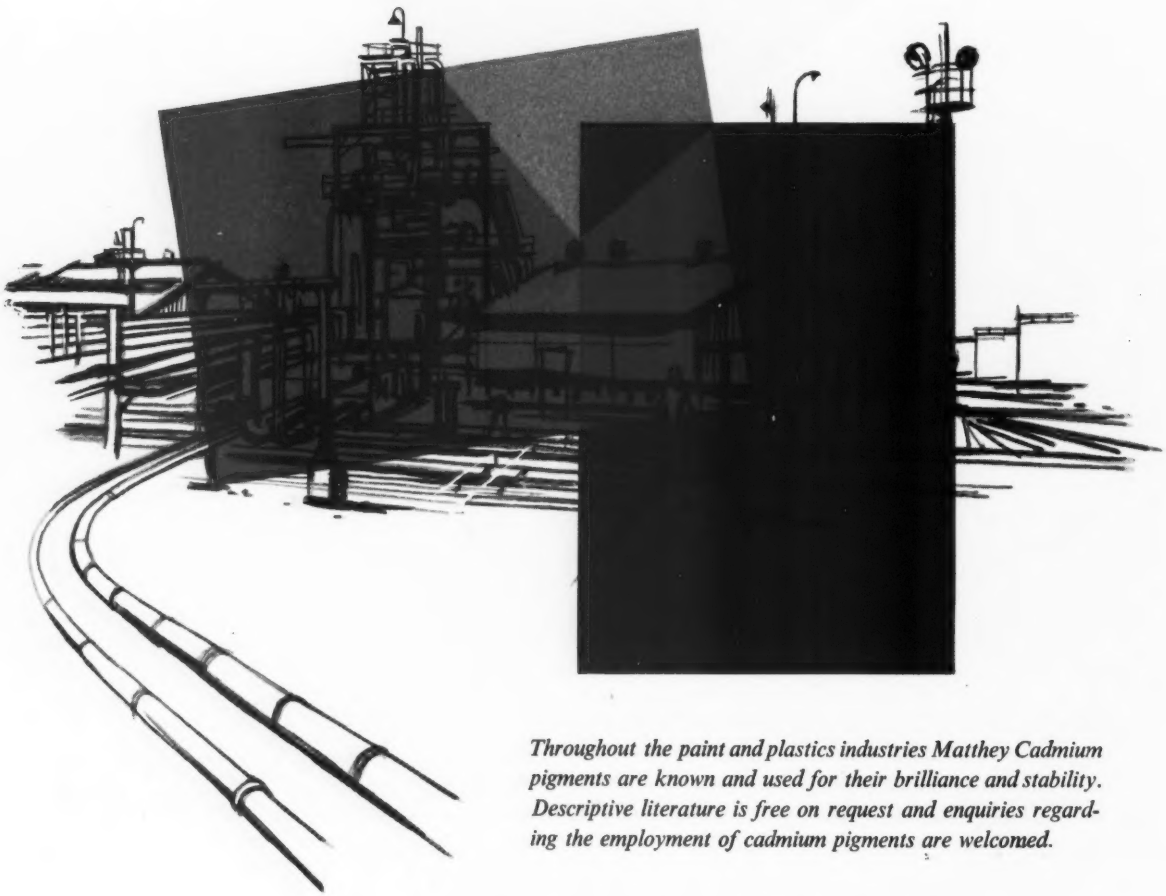

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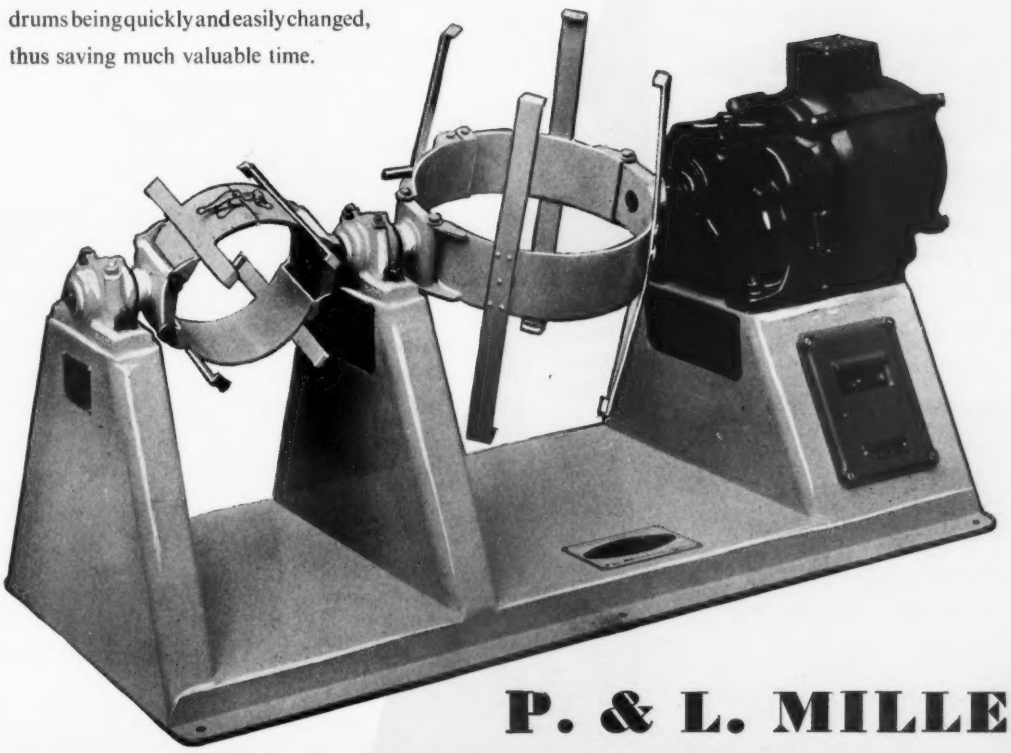

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'PERSPEX' *is the registered trade mark for the acrylic sheet manufactured by I.C.I.*

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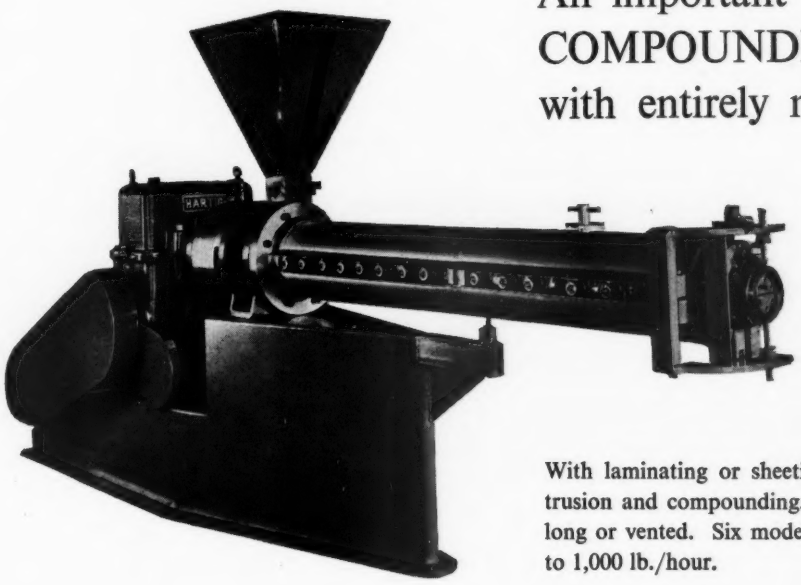

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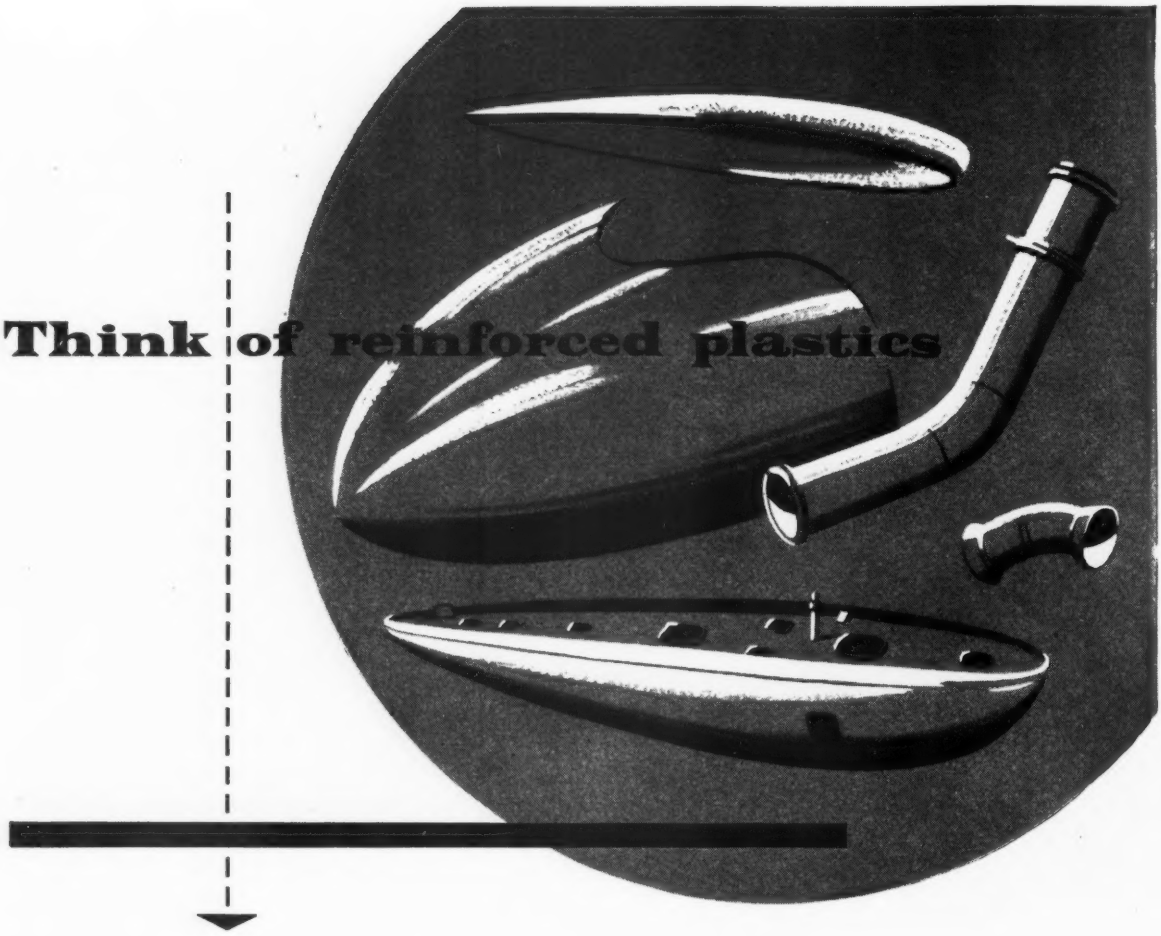

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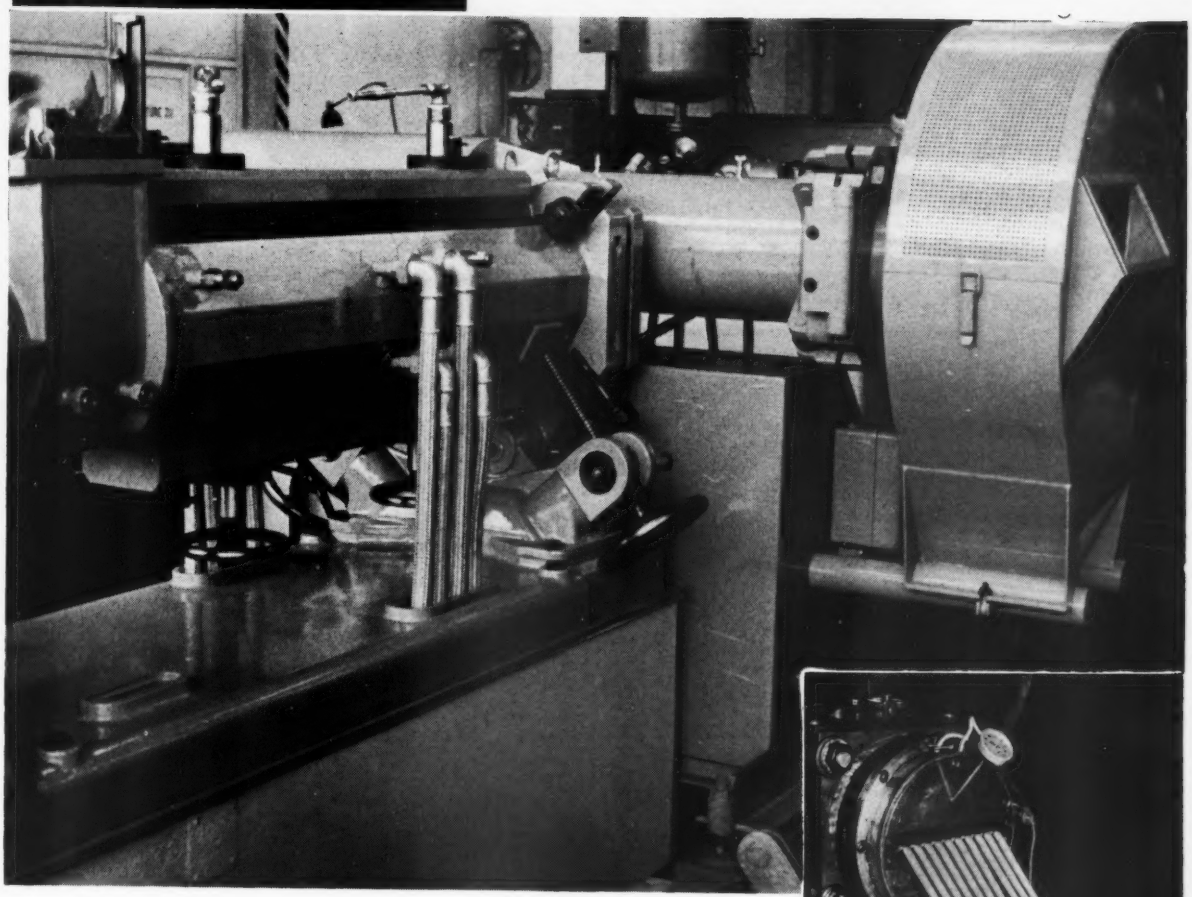

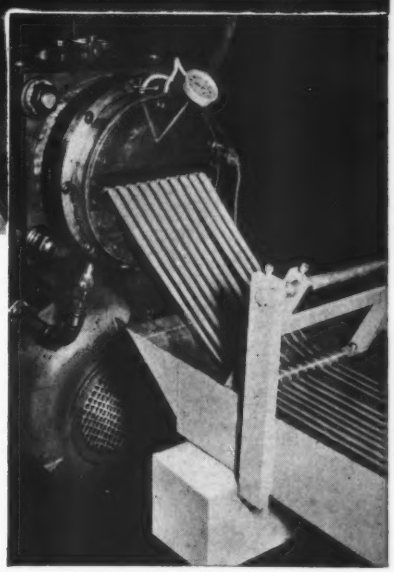

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TELEPHONE : WOLVERHAMPTON 52071 (3 lines)

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CHEMICALS FROM COAL

PHENOL: 39.5/41°C

CRESOLS: 60/64% meta content
ortho, pure grade A

XYLENOLS: 1.3.5.
2.4/2.5
5/7°
(specified cuts as required)

Enquiries to:-

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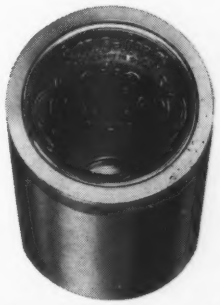
A question of cavities

. . . but not the hard way. If you let us make them for you (or make the complete tool for that matter) then you won't have to sweat over detail or depth. Electroforming takes care of all that—you get a die equivalent in accuracy to the master. What is more—the cavities may cost you from 20% to 80% *less* than by other methods! If you are concerned with injection moulding, blow moulding or slush casting of P.V.C., then you must be interested in electroformed dies. Why not write for literature?

Hard nickel electroformed cavities are extensively used for the Automobile, Electrical, Aircraft, Textile Machinery, Toy and Office Machine industries. They are particularly suited to products requiring intricate detail, relief work or undulating flash lines. The die illustrated below is for the moulding of plastic musical instruments. Even if you are not interested in electroforming, our fully equipped toolroom may still be able to help you. Moulds of all kinds are our speciality.



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have once more enlarged their service to industry by installing machines for the latest vacuum-forming techniques and are enabled to offer an unrivalled service. Our technical sales representatives will be pleased to call and advise on suitable applications, by request.

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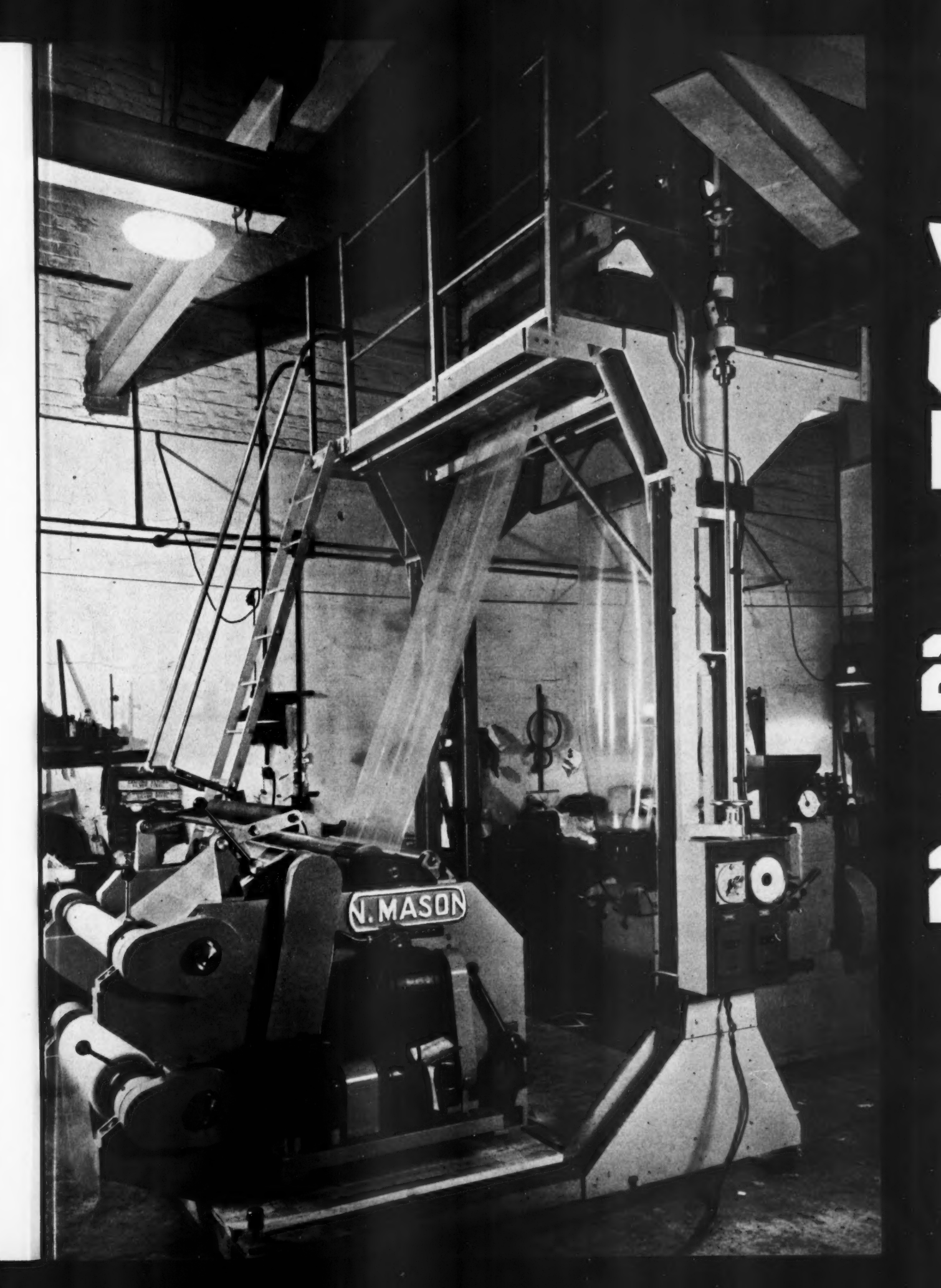
Moulders and fabricators of all plastic materials, including glass and asbestos reinforced laminates, " Perspex," P.V.C., Polystyrene, Cellulose-Acetate Polyethylene, Nylon, Phenol-Formaldehyde, Urea-Formaldehyde, etc.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A versatile intermediate, particularly in the manufacture of plastics, polymers and copolymers for synthetic rubbers, leather substitutes, emulsion paints etc., butadiene is most conveniently transported as liquid under pressure.

Bulk supplies from Grangemouth will normally be delivered in road tank wagons, for transfer to pressure tanks in users' works. Smaller quantities in pressure containers will also be available.

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Hydrogen Chloride Burners—
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In all branches of the plastics industry 'Cintel' Metal Detectors are rightly regarded as an essential part of the manufacturing plant. Only 'Cintel' equipment fully protects calender rollers from damage caused by the presence of tramp metal in the plastic mix.

Full details of how 'Cintel' Metal Detectors can help you are available on request.

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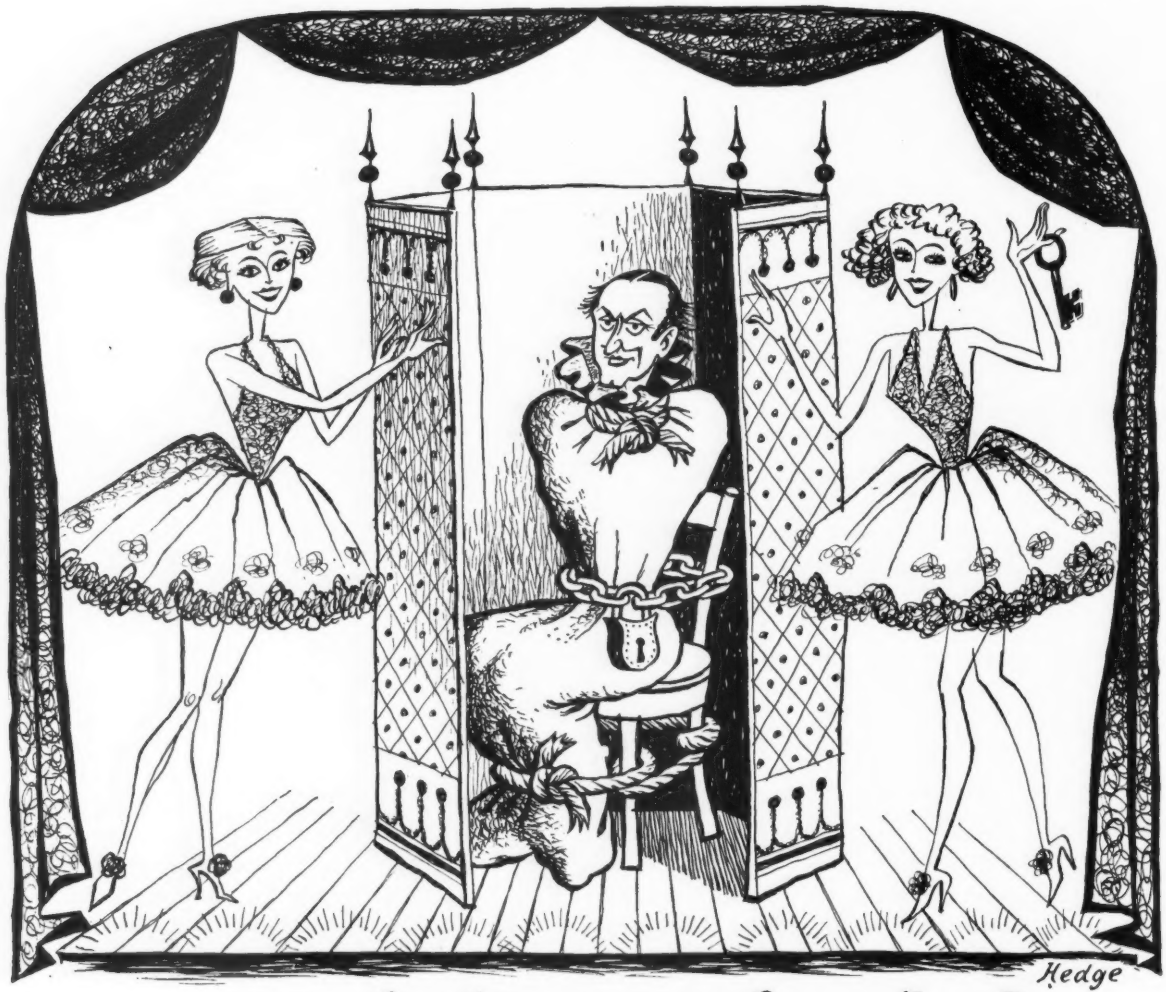

no help required...?

Some people need no help. They can get themselves out of almost any difficult situation—in industry as well as on the stage.

Many, however, need outside assistance and an even greater number recognise the wisdom of employing specialists. As, for example, with tooling.

We specialise in producing moulds and for this purpose maintain an excellent team of experienced designers and craftsmen.

Can we help you?

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Universal Tools Ltd

TOOLMAKERS TO THE PLASTICS INDUSTRY

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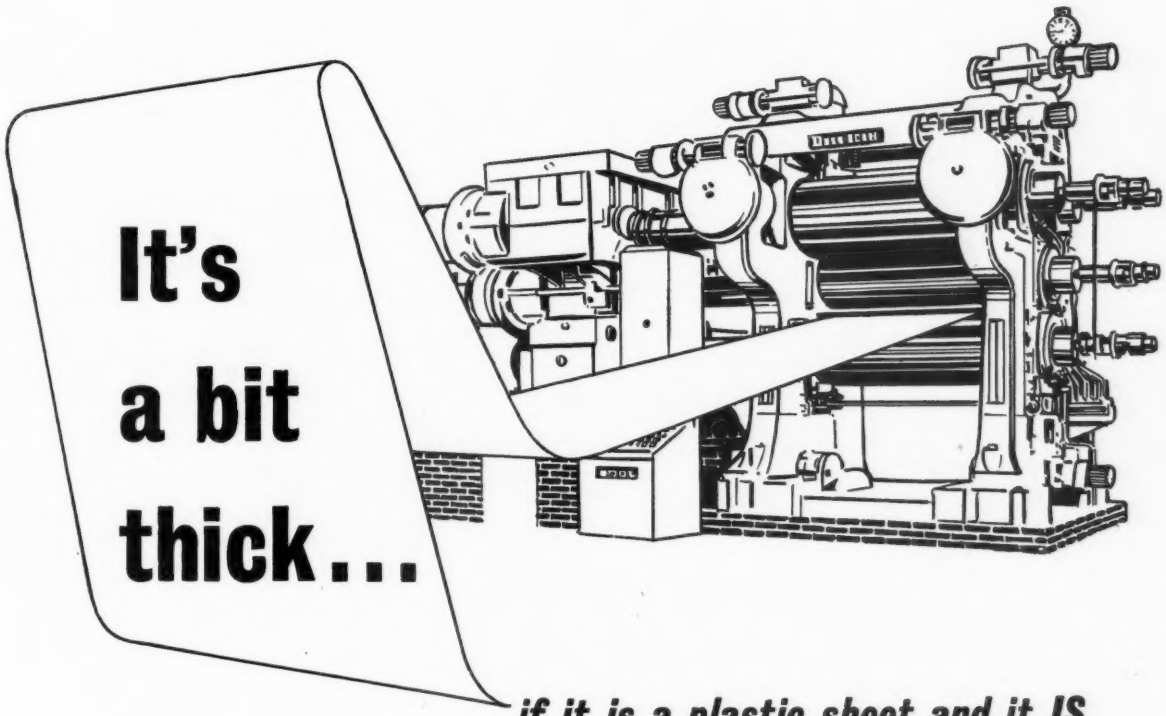


It's a bit thick...

if it is a plastic sheet and it IS a bit thick—or thin—the result is plain...

Somebody is losing money

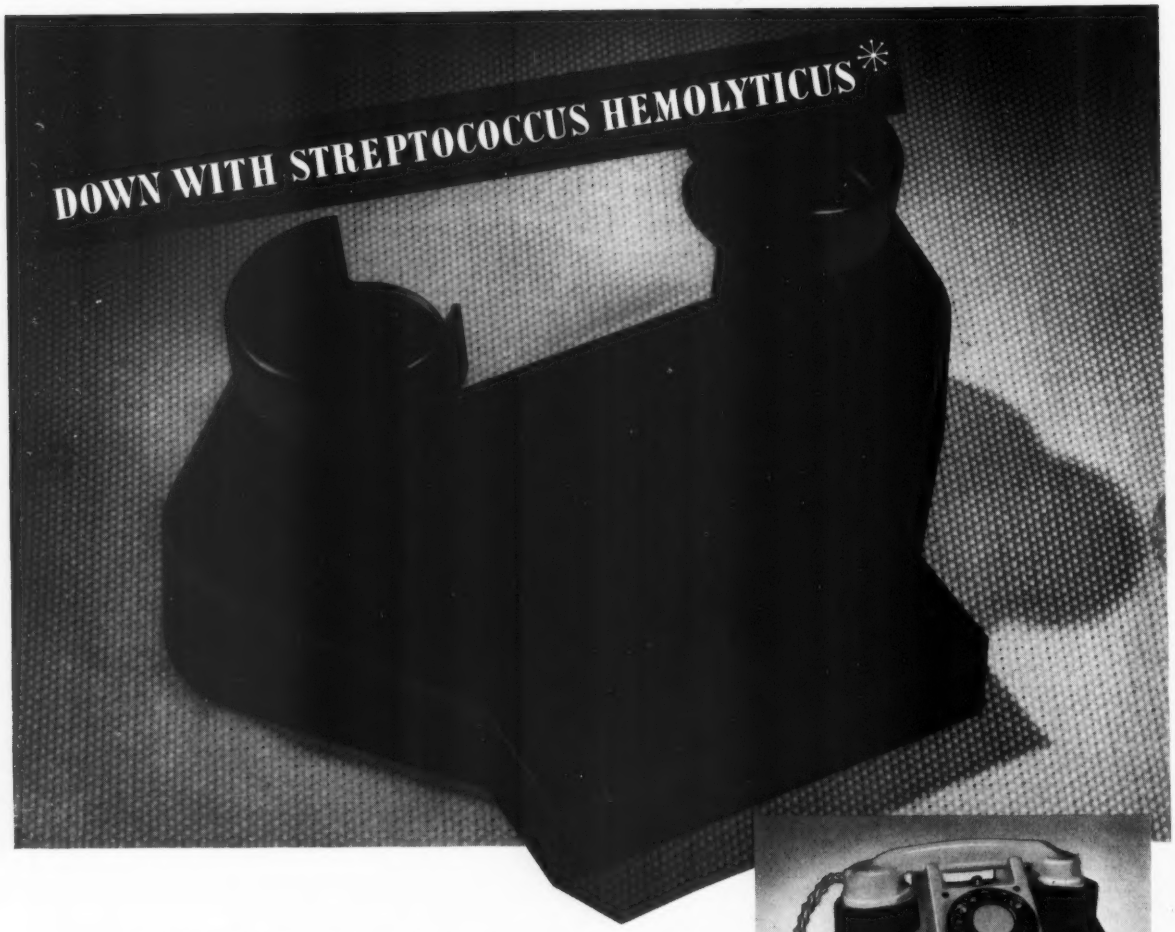
We have had very extensive experience in the development and production of thickness gauges and have supplied large installations to leading manufacturers in Great Britain, U.S.A. and throughout the world. The gauge illustrated below is a new instrument incorporating many outstanding features.

Without touching the flowing sheet the EKCO NUCLEONIC THICKNESS GAUGE eliminates test sampling by giving continuous indication of thickness: it provides immediate warning of variation: it reduces time taken in arriving at the correct thickness when starting up: accuracy is in order of 1% and it is suitable for measuring all plastic materials. The Ekco Nucleonic Thickness Gauge is a time and money saver to everyone who needs control over the thickness of continuous plastic sheet, and coatings of any type on plastic sheet. We shall be pleased to send you further details of the Ekco Nucleonic Thickness Gauges or our Technical representatives will be glad to call and discuss your requirements without obligation.

EKCO

nucleonic thickness gauges

EKCO ELECTRONICS LTD • EKCO WORKS • SOUTHEND-ON-SEA • ESSEX



We had a double incentive in tackling this job. First, some moulders regarded it as impracticable or even impossible as a moulding proposition. Second, it was one of the most effective solutions we have ever encountered to absenteeism due to the common cold, which is responsibie for more lost hours in industry than a combination of all other diseases. Doing the impossible, is almost routine for us. Impossible and impracticable are words you won't find in our vocabulary. With four factories at our disposal, equipped with the most up-to-date moulding plant and machinery, we are capable of handling the longest runs and most difficult propositions. We would welcome your enquiries.

E. Elliott LIMITED.

* The mouldings were for the Sterl-a-phone, manufactured by E.R. APPLIANCE MFG. CO., LTD., LEYTONSTONE, E.11. This unique telephone attachment incorporates infra red lamps which destroy streptococcus hemolyticus, diplococcus pneumonia, staphylococcus aureus and other bacteria harboured in telephones. The instrument gives immunity for one fifth of a penny per hour, killing bacteria between calls.

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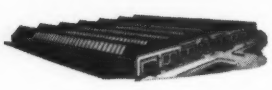
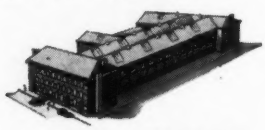
Cheapside Works

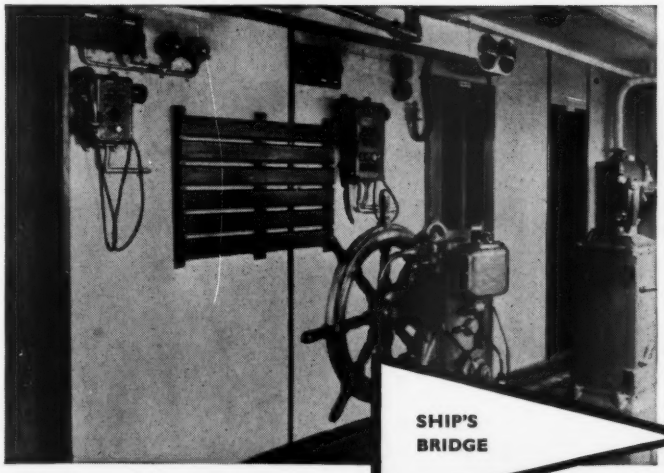


Walsall Works (Bescott Crescent)

Victoria Works (Summer Lane)

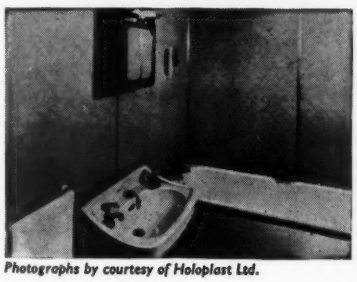


Walsall Works (Eldon Street)



SHIP'S BRIDGE

RADIO ROOM



OWNER'S BATHROOM

Photographs by courtesy of Holoplast Ltd.

A famous laminate goes to sea

The new motor vessel Victoria City is fitted throughout with *Decorplast*, the strong, hardwearing material surfaced with MELAMINE resins.

Handsome Decorplast panels have been employed for the Dining Saloon, Smoke-room, Officers' Cabins and in the Captain's and Owner's suites.

For divisional bulkheads in the crew's quarters 1″ Decorplast structural panels were chosen. These are very attractively finished in MELAMINE resins in various patterns and colours. Decorplast facings have also been supplied to match the Decorplast structural panels.

For facing bathrooms and covering table and dressing-table tops, sheets of Decor-plast were the obvious choice.

Laminates based on MELAMINE resins are not for ships alone—their application in the Victoria City is but another instance of their exceptional versatility.

Marvellous!

MELAMINE

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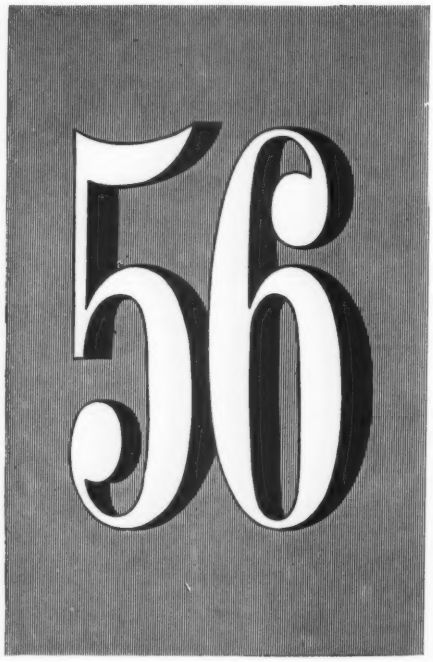
LONDON OFFICE: BRIDGEWATER HOUSE, ST. JAMES'S, S.W.1. TEL: WHITEHALL 9777

Names and addresses of manufacturers of Melamine resins and moulding powders will be supplied with pleasure



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56 years of moulding plastics to high precision limits for government and industrial applications at your service

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OSBORN WEIGH-FEED ATTACHMENT to INJECTION MOULDING MACHINES

- Entirely automatic and continuous in operation.
- Reduces moulding powder costs.
- Accuracy of plus 2% of weight required.
- Sound mouldings produced from 4% to 5% lighter in weight and of same thickness.
- Mouldings of large projected area are possible.
- Higher injection pressures obtained.

(Above) Herbert/Reed-Prentice Machines fitted with the Osborn Automatic Weigh-Feed Attachment which can also be fitted to Edgwick HY and other makes of Injection Moulding Machines.

For injection mouldings we can supply :—

Herbert/Reed-Prentice Machines, Manual, Semi- or Fully-automatic in operation. Double-Shot Mechanism is fitted to increase capacity by double packing.

		175T	10D*	400T*
Moulding Capacities	...	4–6 oz.	8–14 oz.	16–22 oz.
Locking Pressure	...	175 tons	250 tons	400 tons

*** Edgwick " HY " with either semi- or fully-automatic operation and 1½ oz. capacity. Double-Shot Mechanism can be fitted.**

** IN STOCK*

ALFRED HERBERT LTD., COVENTRY

FACTORED DIVISION, RED LANE WORKS

AD167

accumulated experience

When Peto & Radford Ltd. started development on this R.A.F. type aircraft battery to meet a Ministry of Supply contract, they consulted the EKCO PLASTICS Advisory Service. Between us we discussed the particular problems relating to the job and chose injection moulding for the case and other components. Low weight, high moisture and acid resistance, excellent electrical properties and strength were the vital considerations. With close co-operation at every stage of manufacture, the batteries when produced met all these requirements. Reduction in weight is particularly noticeable: with two batteries employed per aircraft, the saving is as much as 28 lbs.

No matter what *your* requirements are, we invite you to discuss them with us. If you have a plastic moulding problem, we'll find the answer.

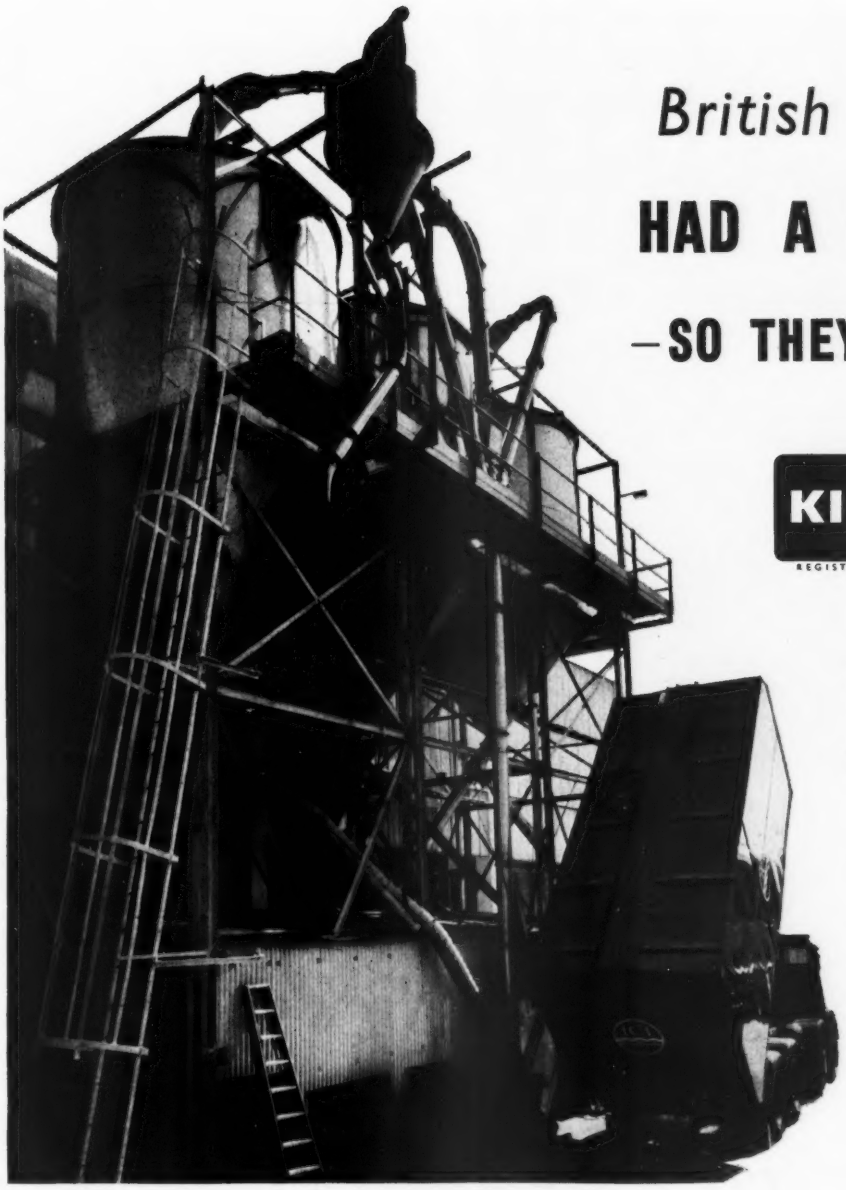
TECHNICALLY SPEAKING

The case, cell lids, cell spacers, terminal connectors and inter-cell connectors of this aircraft battery were injection moulded by EKCO PLASTICS from Styron 475.

EKCO *PLASTICS FOR INDUSTRY*

E. K. COLE LTD • EKCO WORKS • SOUTHEND-ON-SEA • ESSEX

(MEMBERS OF THE BRITISH PLASTICS FEDERATION)



British Visqueen

HAD A PROBLEM

—SO THEY CALLED IN

KING
REGISTERED TRADE MARK

(and got things moving)

British Visqueen Limited, was faced with a poser. How to unload and store granules in sacks? It seemed at first that the handling difficulties were bound to be many and the costs in proportion—until, that is, they called in Geo. W. King Ltd., the specialists in materials handling and asked them for their solution.

KINGS designed and installed a completely enclosed, dustproof and weatherproof, pneumatic system of unloading and storage which has made possible a considerable saving in labour, handling charges and storage space.

The granules are conveyed from road tankers to storage hoppers which each hold 12 tons. This involves a lift of 45 feet. After they have been automatically fed into the hoppers, the granules are all set for their journey to the production line, their flow being controlled by valves which are operated from inside the factory. Special precautions are taken to reduce static electricity generated in handling.

This is just another of the hundreds of instances in which KINGS have helped industry perform its functions more efficiently. Have *you* handling problems? If so, why not hand them to KINGS who are the experts? Their representative will call on you—anywhere in the world.

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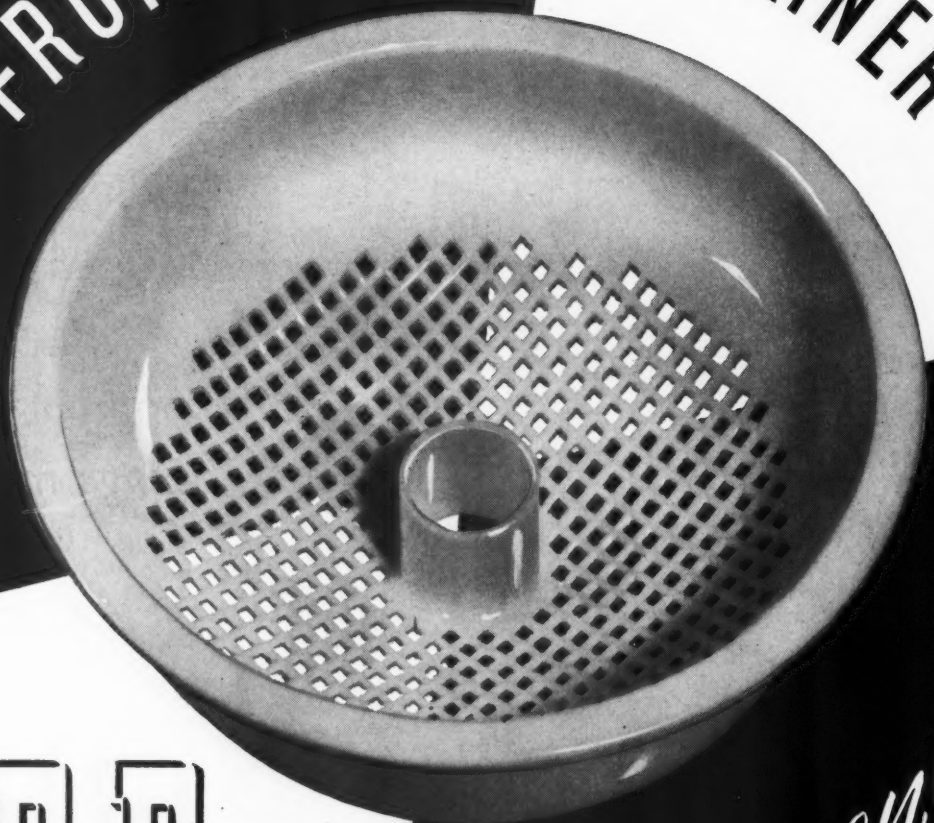
FRUIT JUICE STRAINER



P&B IN *Polystyrene*

INJECTION MOULDING *Specialists*

If you require mouldings of the highest quality and dimensional accuracy at competitive prices— get in touch with us.

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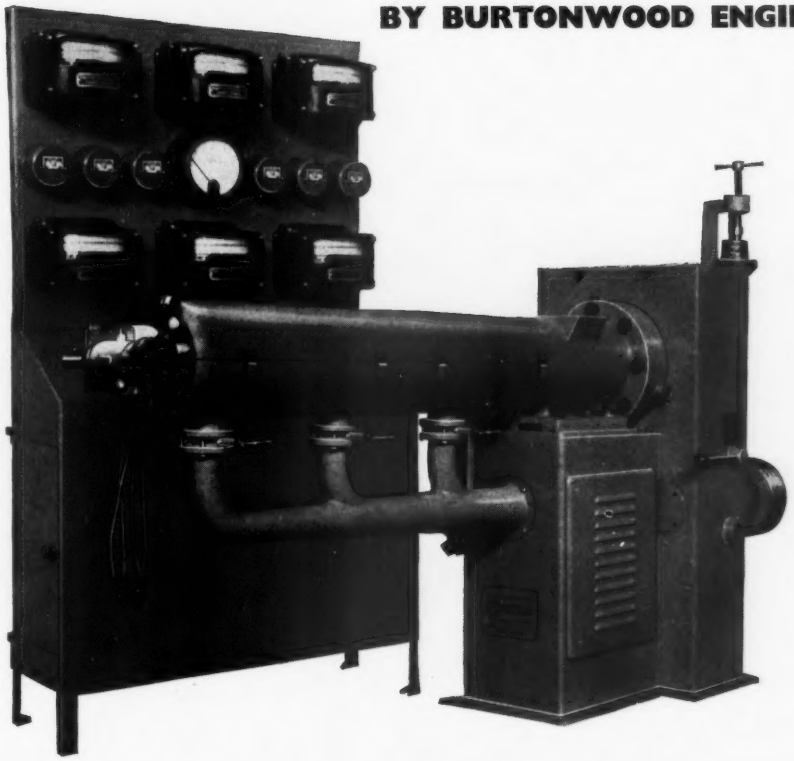
Special announcement

BY BURTONWOOD ENGINEERING CO., LTD.



BURTONWOOD-ANDOUART EXTRUDER

We are pleased to announce that as from 1st July, 1956, we shall have available and will build under licence the complete range of Andouart Extruders, Take-off Equipment, and Dies, etc.

Andouart Extruders have for years played an important part in the cable and plastic industry, not only in France, but in the United Kingdom, Commonwealth and throughout the world. In fact, the foremost cable manufacturers and plastic fabricators have chosen Andouart Extruders because of their dependability.

The Burtonwood Engineering Company have been manufacturing extrusion components, high pressure fittings, dicing and granulating machines for many years, and our products have the stamp of distinction.

For literature, demonstrations, appointments and technical advice, apply to the sole agents, Messrs. Warbrick (Engineering Specialties) Limited, Barclays Bank Chambers, Sankey Street, Warrington, Lancashire.

BURTONWOOD ENGINEERING COMPANY LIMITED

Burtonwood, Warrington, Lancashire. Telephone: Newton-le-Willows 3311 (10 lines)

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THE NEW IMPROVED HUPFIELD 1¼ & 2¼ OZ CAPACITY INJECTION MOULDING MACHINES

Improvements include, quick purging of heating cylinder, a faster pump giving a 6 sec dry run, adjustment of injection pressure independent of mould locking pressure, a larger plasticizing capacity, and many other improvements which are the outcome of years of experiments in close co-operation with our customer's requirements. For particulars please write to:

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Your enquiries are invited for

A fully automatic controlled cycle attachment which can now be supplied for these machines

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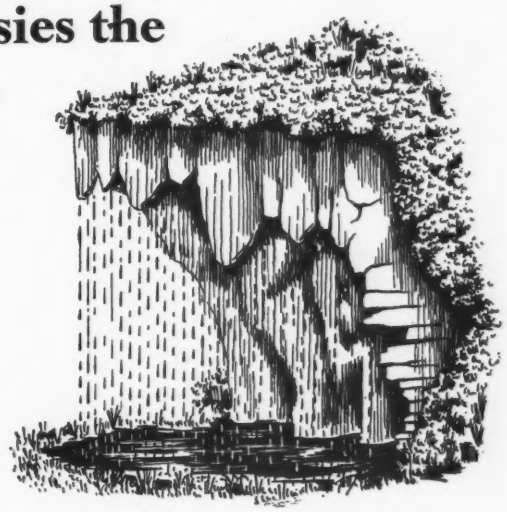
Mother Shipton prophesies the fate of Cardinal Wolsey

The world-famous prophetess was born at Knaresborough. When it was announced that Cardinal Wolsey was to visit York she prophesied that the Cardinal should see York but never enter it, and hearing this the Cardinal sent the Duke of Suffolk to see her. She was threatened with burning as a witch but she refused to retract her words.
Cardinal Wolsey set off for York, and was apprehended at Cawood, a nearby village, on a charge of high treason. As Mother Shipton had foretold, he never entered York and was taken away in custody.



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Birkbys Ltd. Liversedge Yorkshire, Makers of Elo Plastics Products

THE MITCHELL ORGANISATION AND THE PLASTICS INDUSTRY

The Mitchell Coating, Stoving and Drying plant illustrated below is installed for use in the production of Formica decorative boards in the modern factory of Thomas De La Rue & Company Limited.

MITCHELL Impregnators for the production of laminates.

Mitchell modern continuous impregnators are supplied of the horizontal and vertical types for coating, impregnating and stoving papers and fabrics for the manufacture of laminated products.

Materials handled in Mitchell impregnators include:
ASBESTOS for giving increased heat resistance.
PAPERS for electrical insulation.
DECORATIVE BOARDS for the furniture trade.
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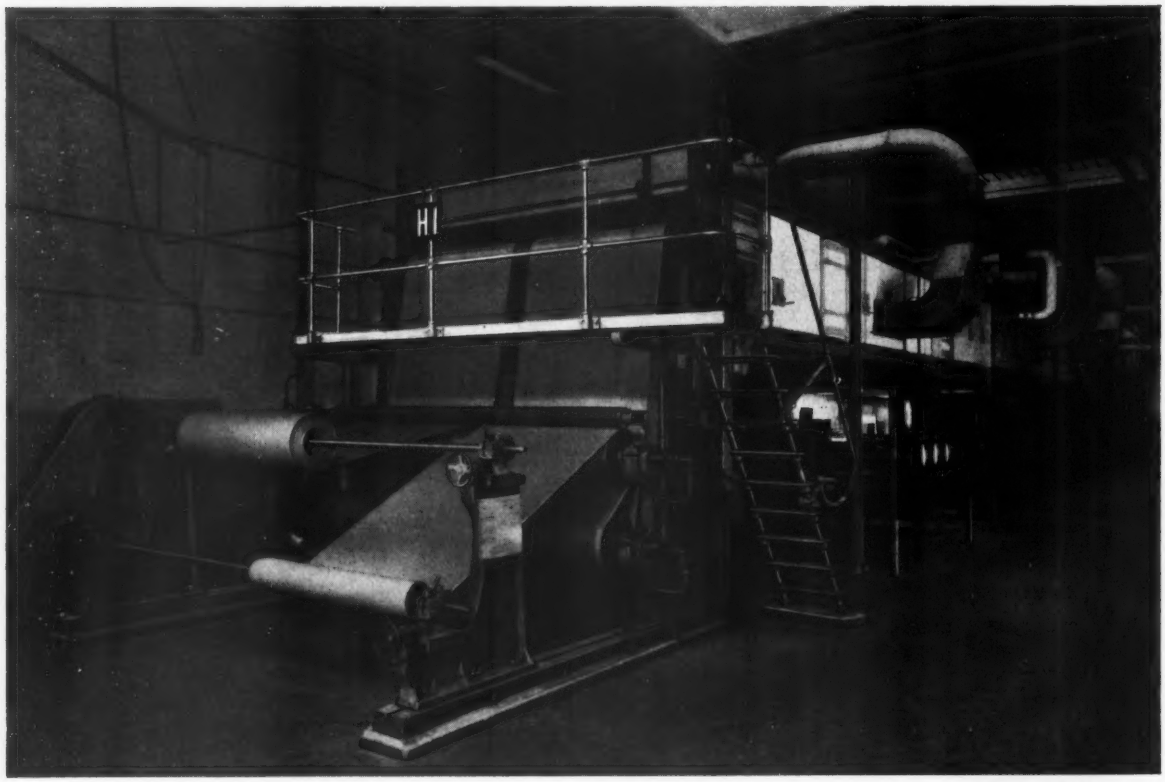
GLASS FIBRE SHEETING for insulation.

Our experience over many years in the Plastics and Chemical Engineering industry is at your disposal. Plants designed to suit customers' specific requirements.

Enquiries also invited for stoving ovens for resin coated components and parts—complete synthetic resin distillation plants—fluid agitating and mixing equipment, comprising propeller type mixers, turbo agitators, side entry mixers for chemicals, resins and plastics—Sparkler horizontal plate Filters for clarifying and polishing resins, etc.



L. A. MITCHELL LTD. 37 Peter St, Manchester.

Industrial Drying Engineers *Phone: BLAckfriars 7224 (4 lines)*

MD.60

CRAYMAC

sets the fashion in plastic rainwear

This is "Twig"

This is "Firework"

This is "Snowflake"

The captivating printed and textured effects of Craymac give plastic rainwear a greater and greater fashion interest. Colours and textures become part of the fabric and cannot wash or wear off. Craymac is manufactured to British Standards Institution Specification No. 1763.

Serial No ★ 1923
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GOOD HOUSEKEEPING INSTITUTE
GUARANTEES
REFUND OF MONEY OR REPLACEMENT IF NOT IN CONFORMITY WITH THE INSTITUTE'S STANDARDS

See the latest designs and textured effects before you next order plastic rainwear material. Send for pattern folders showing full range to:

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ST. MARY CRAY, KENT, ENGLAND.

Telephone: Ravensbourne 4674/5 and Orpington 25671/2/3

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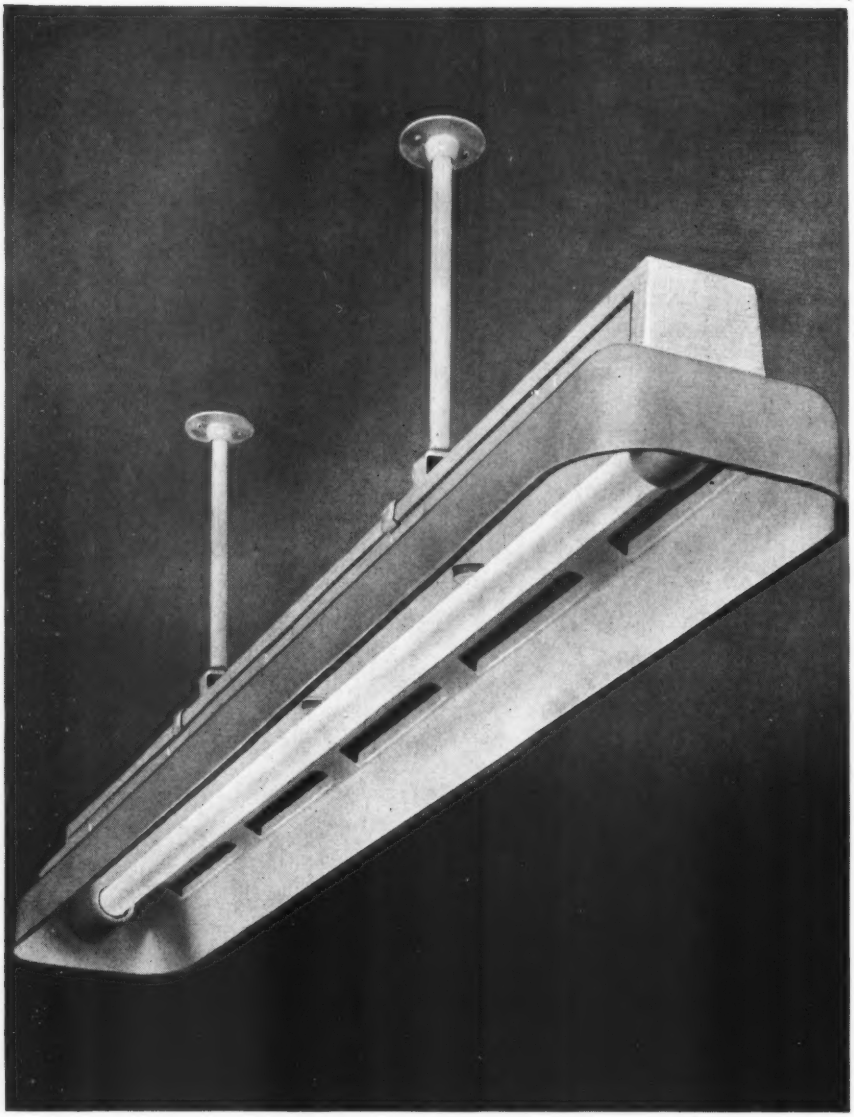


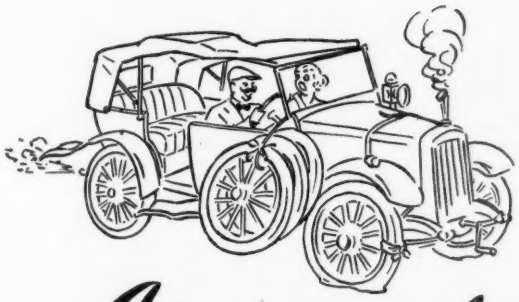
Fitting illustrated
F62060/1

You'll be glad it's . . .

- *Each fitting is the result of the closest collaboration between expert designers and lighting engineers.*
- *Each fitting is made to rigid factory standards for long arduous service.*
- *Operating efficiency is guaranteed because the control gear and tubes are made within the G.E.C. organisation.*
- *Consult your contractor for the most suitable G.E.C. fittings . . . with OSRAM tubes of course.*

G.E.C.

● *The General Electric Co. Ltd, Magnet House, Kingsway, London WC2*



You wouldn't dare

be seen around in this———it's out of date and retards progress. The same applies to many existing moulding machines———they're out of date and reflect no credit on production.

You must have up-to-date machines to meet modern competition.

The new E.M.B. No. 9c embodies many improvements :—

- ★ A 6 oz. cylinder with increased plasticizing capacity.
- ★ Many times the injection speed of previous E.M.B. machines and variable down to the slowest required.
- ★ Automatic temperature controller by Kelvin & Hughes individually controls 5 heating units.
- ★ Time of cyling speed halved.
- ★ Adjustable platen stroke.

Catalogue M326 gives full particulars.

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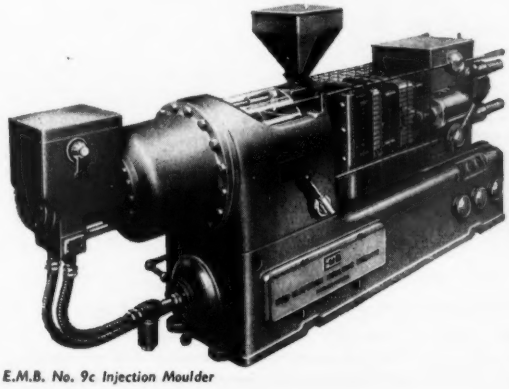
Established 1908

For many years E.M.B. Injection Moulders have given wonderful service in the industry. Now the capacity and speed have been stepped up to meet modern conditions.



E.M.B. No. 9c Injection Moulder

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Subject to prior sale

E.M.B. Co. Ltd

Die Casting Machines, Injection Moulding Machines, Air Presses, Electrical Control Gear

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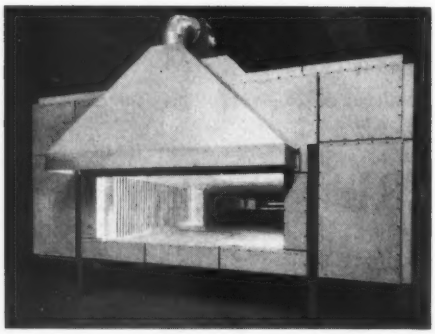

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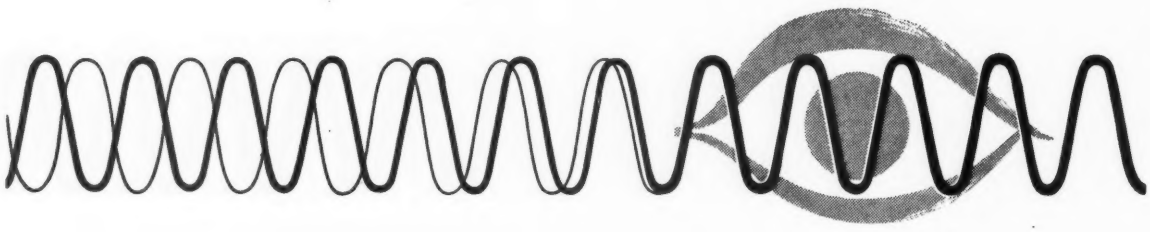

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Ask your ELECTRICITY BOARD for advice and information, or get in touch with E.D.A. They can lend you, without charge, films about the uses of electricity in industry. E.D.A. are also publishing a series of books on Electricity and Productivity. Titles now available are: Electric Motors and Controls, Higher Production, Lighting, Materials Handling, and Resistance Heating. Price 8/6. or 9/- post free.

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a 3 G.P.M. pump
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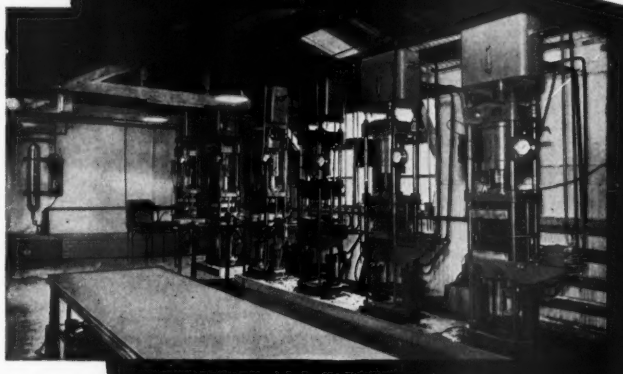

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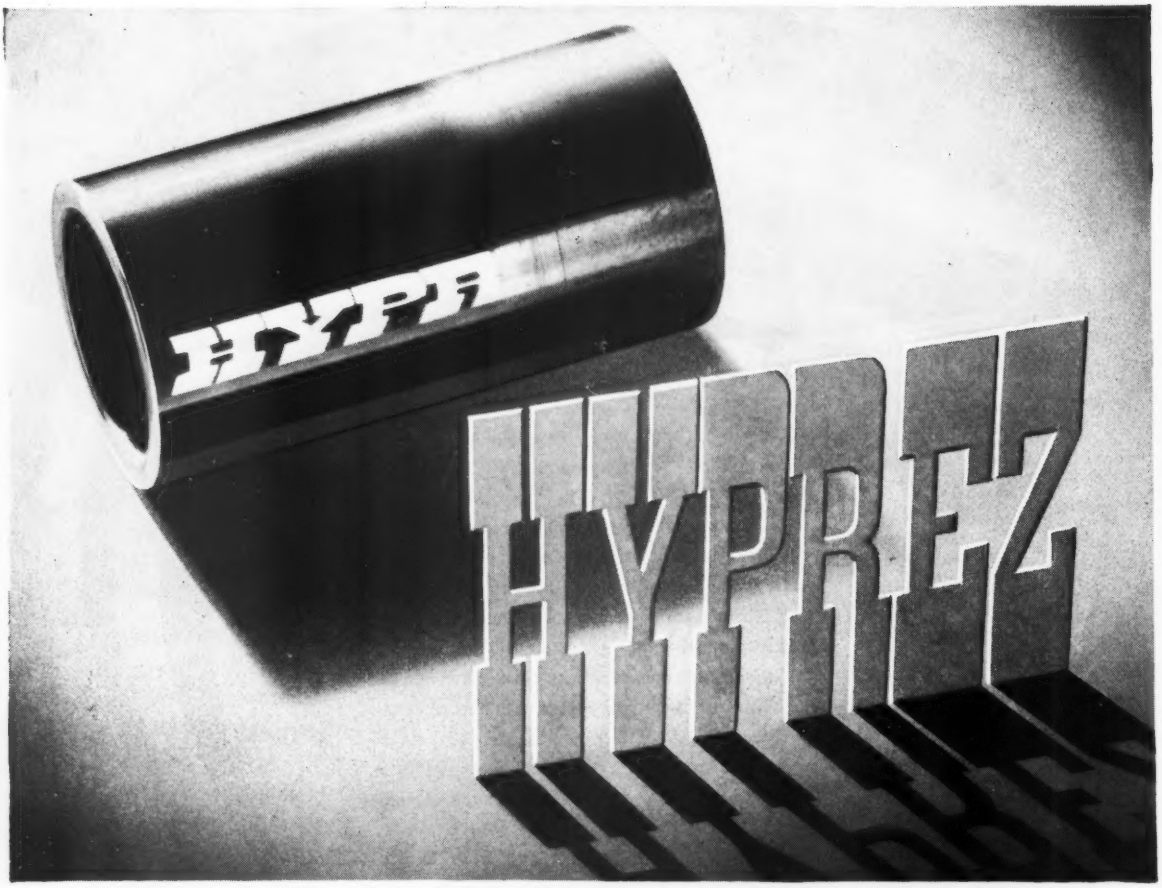
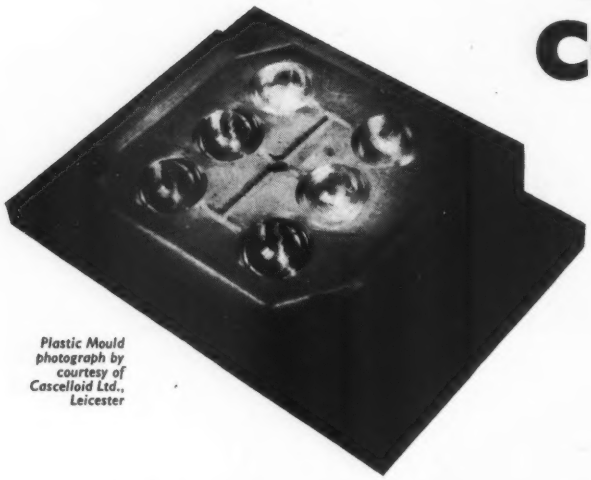


DIAMOND COMPOUND



Plastic Mould photograph by courtesy of Cascelloid Ltd., Leicester

imparts to plastic moulds a finish which is reflected in the product.

The illustration (left) shows a plastic mould part-finished with Hyprez, part-finished to a normal degree.

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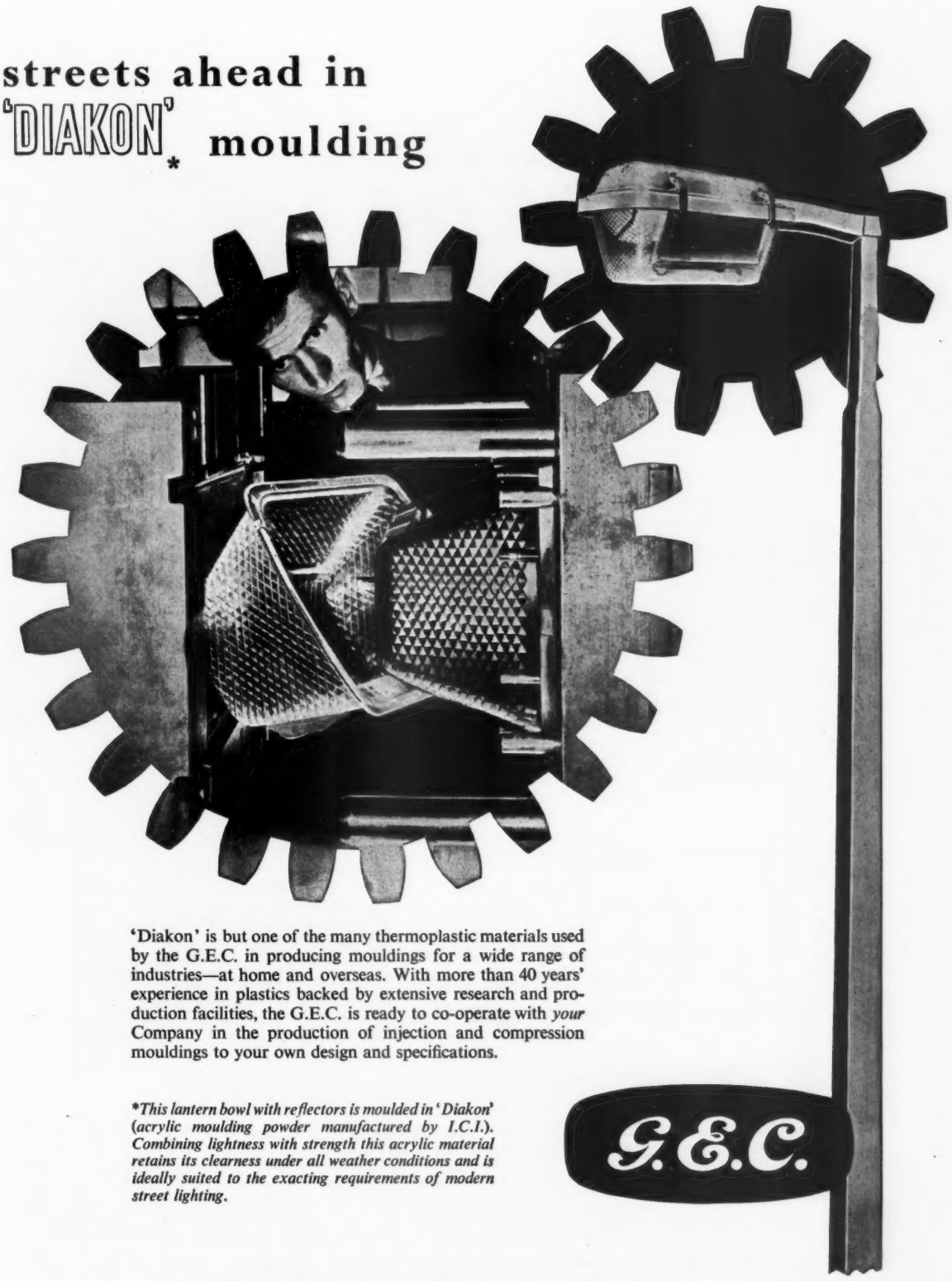

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**This lantern bowl with reflectors is moulded in 'Diakon' (acrylic moulding powder manufactured by I.C.I.). Combining lightness with strength this acrylic material retains its clearness under all weather conditions and is ideally suited to the exacting requirements of modern street lighting.*

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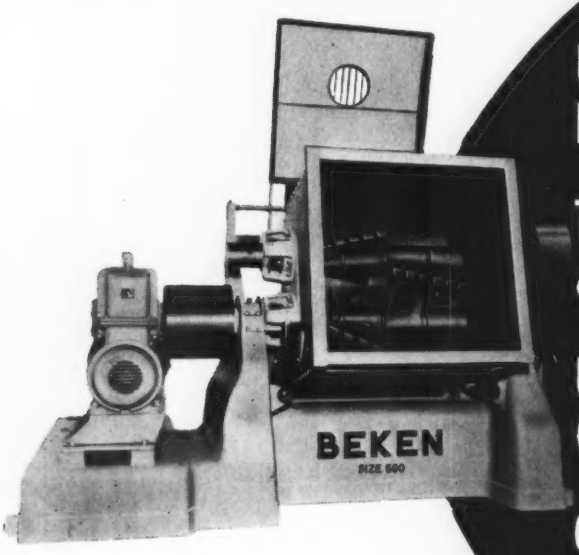

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MANUFACTURERS OF REINFORCED LAMINATES AND MOULDINGS

YOUR REF: GBJ/JFA OUR REF: RS/SU/ML DATE: 24th May, 1956.

Messrs. James Beadel & Co. Ltd.,
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LONDON, E.C.4.

Dear Sirs,

We thank you for your letter of the 23rd May with regard to the question of fire retardant resin and note your remarks with interest. By a remarkable coincidence we have received a letter to-day from a firm of builders' merchants to whom we supplied corrugated translucent sheeting made with your Filabond 1345 Resin, advising us that some of these sheets which were installed in a shop in Weston-Super-Mare were involved in a fire on the premises during Whitsun. The shopkeeper reports that the fire our "Rufelite" sheeting helped to hold back the spread of flames and he is therefore very keen on the product.

This undoubtedly answers the question of fire resistance which we had been discussing with you and we feel you will agree that one eventuality of this nature is worth a good deal of abstract laboratory investigations.

Yours faithfully,
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R. Sheridan

Director.

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INSTALLATION AND OPERATI

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Where the mixer is located on a mezzanine directly above the sheeting mill, the mixed stock, when discharged, drops into the bite of the rolls and can be

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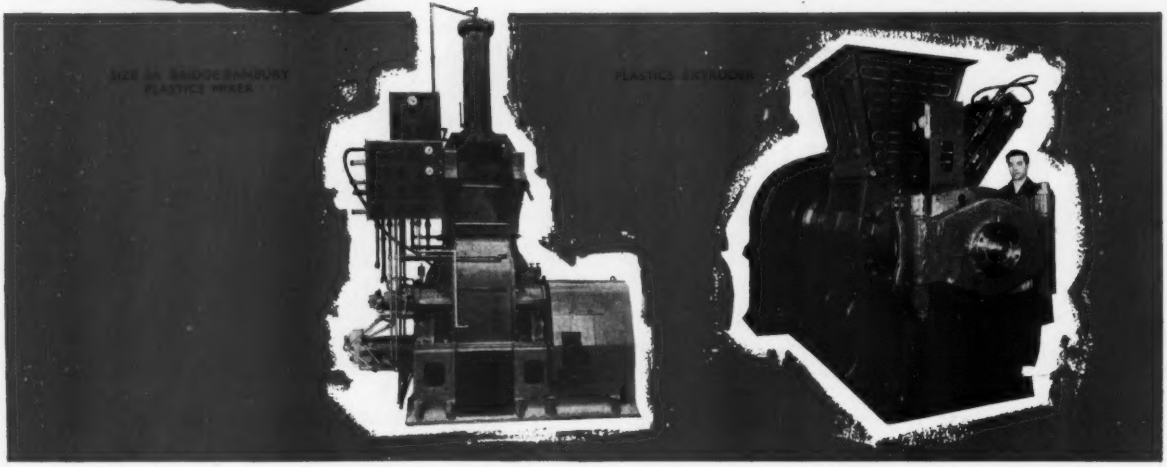
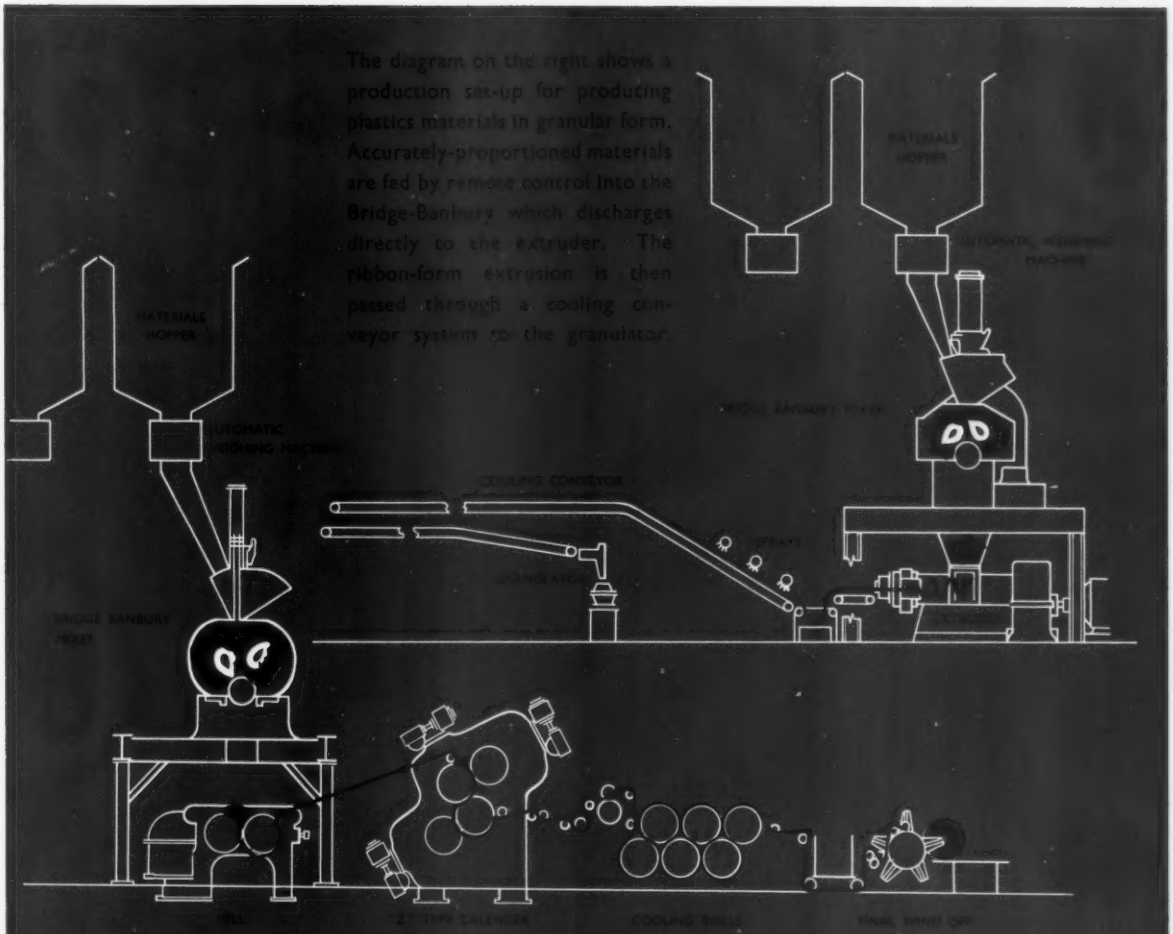
We know it as a cat. You can refer to a highly efficient continuous production method as "automation." We know it as a system which we have recommended and applied all along to our BRIDGE-BANBURY Matched Production Processing Units. On the left is a reproduction of a portion of our catalogue published a long time before the word "automation" became so popular. Proof indeed that what is now hailed as the ultimate in efficiency, has in fact been available to BRIDGE-BANBURY users for years.



The diagram on the right shows a production set-up for producing plastics materials in granular form. Accurately-proportioned materials are fed by remote control into the Bridge-Banbury which discharges directly to the extruder. The ribbon-form extrusion is then passed through a cooling conveyor system to the granulator.



Above is a schematic layout showing controlled automative production of medium thin, and heavy gauge unsupported plastics sheet, or extra thin p.v.c. film in the 1½ thou" to 3½ thou" range. The speed of production through the calender to final winding-off is up to 100 yards per minute.

Many major plastics and rubber manufacturers throughout the world enjoy the benefits of high quality production, maximum output, reliability, minimum labour costs with the maximum efficiency and safety provided by BRIDGE-BANBURY installations.

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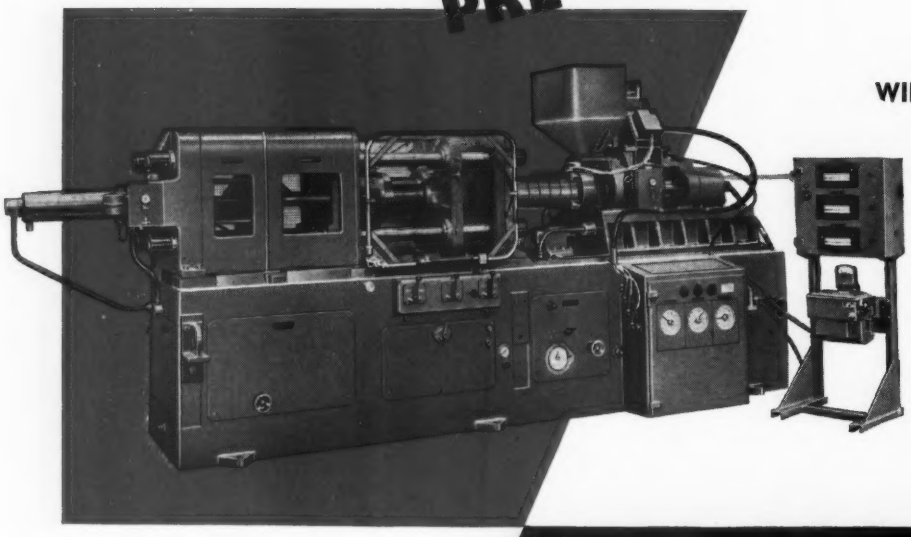

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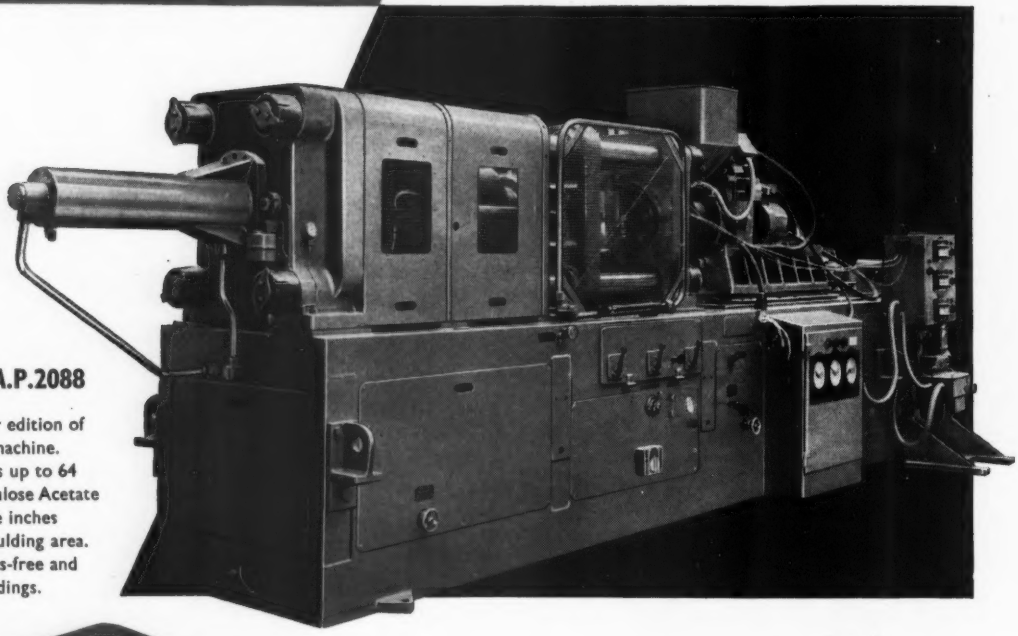

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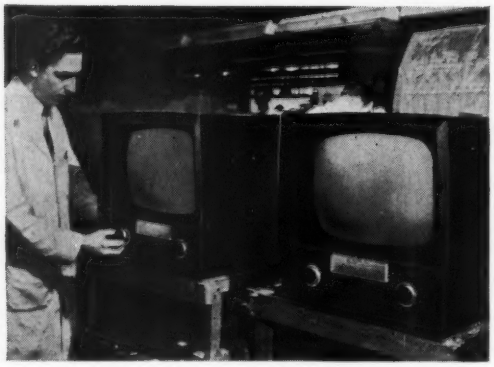

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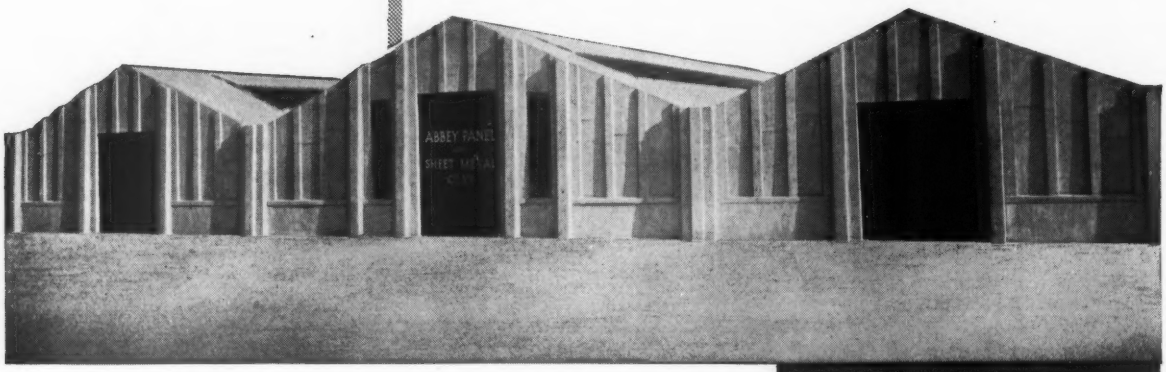

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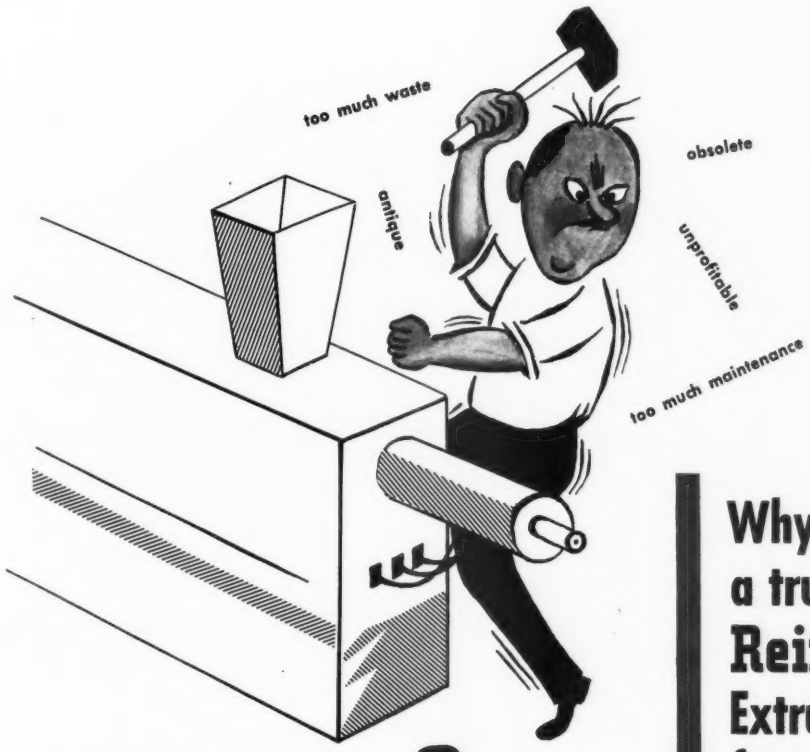

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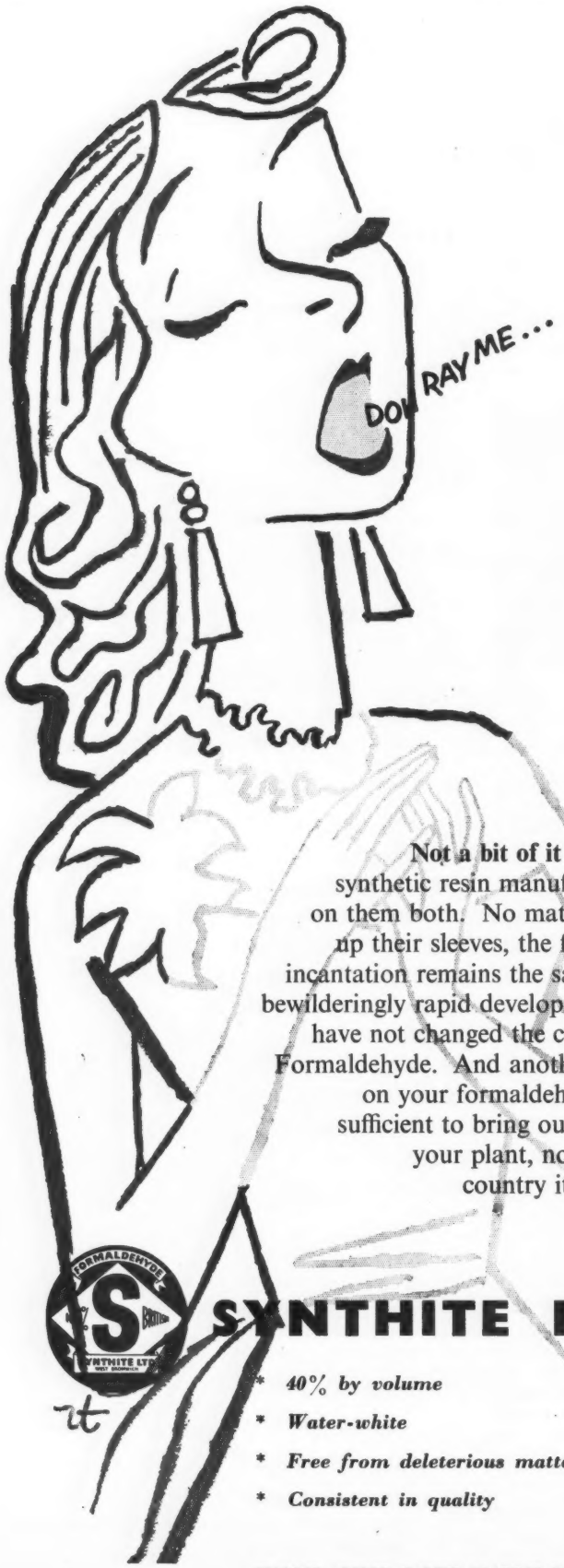

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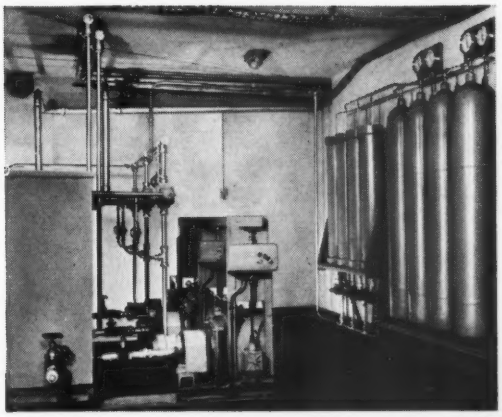

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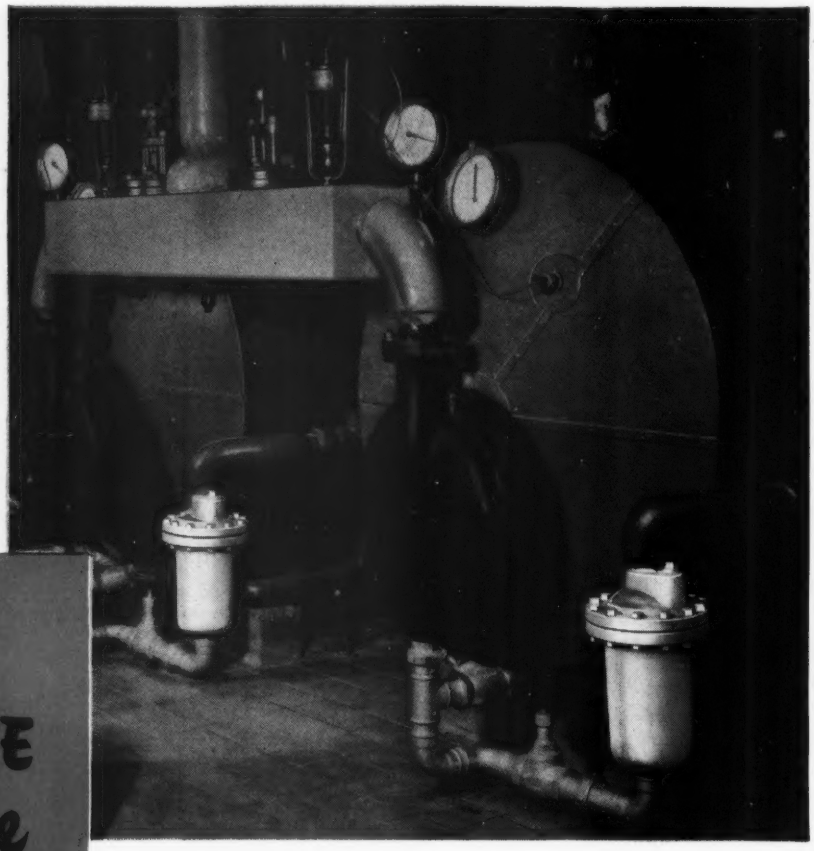

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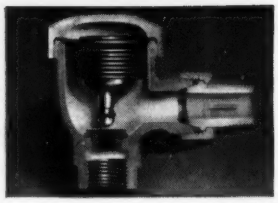

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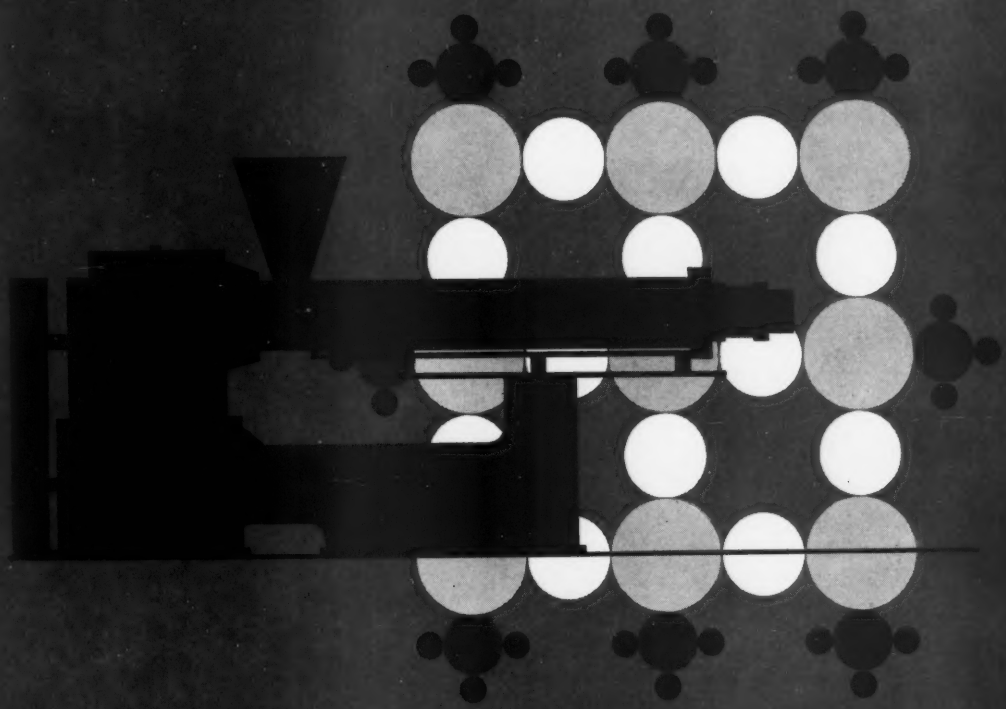

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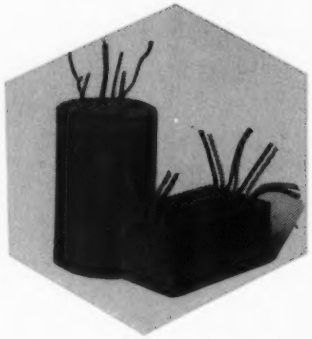

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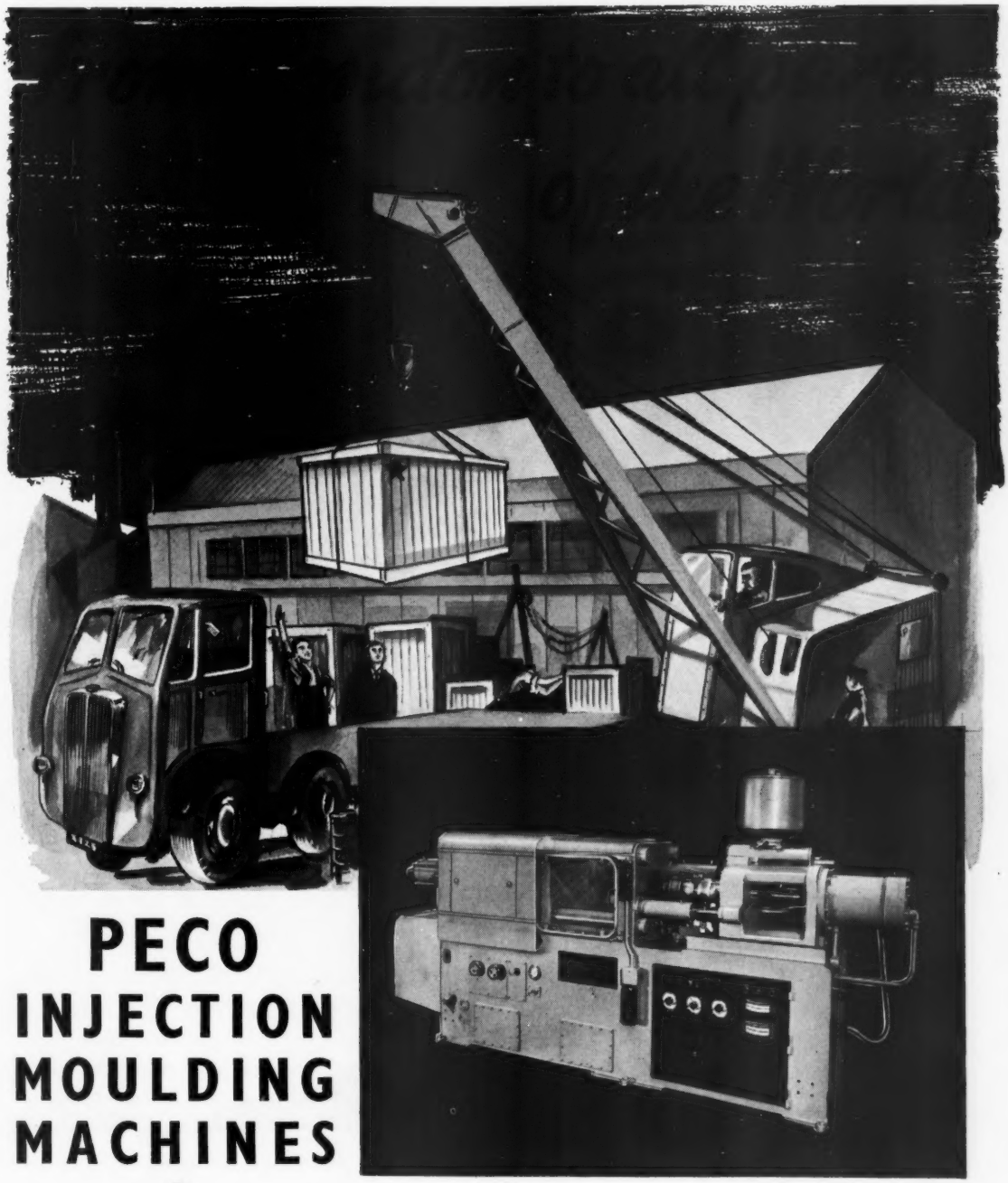

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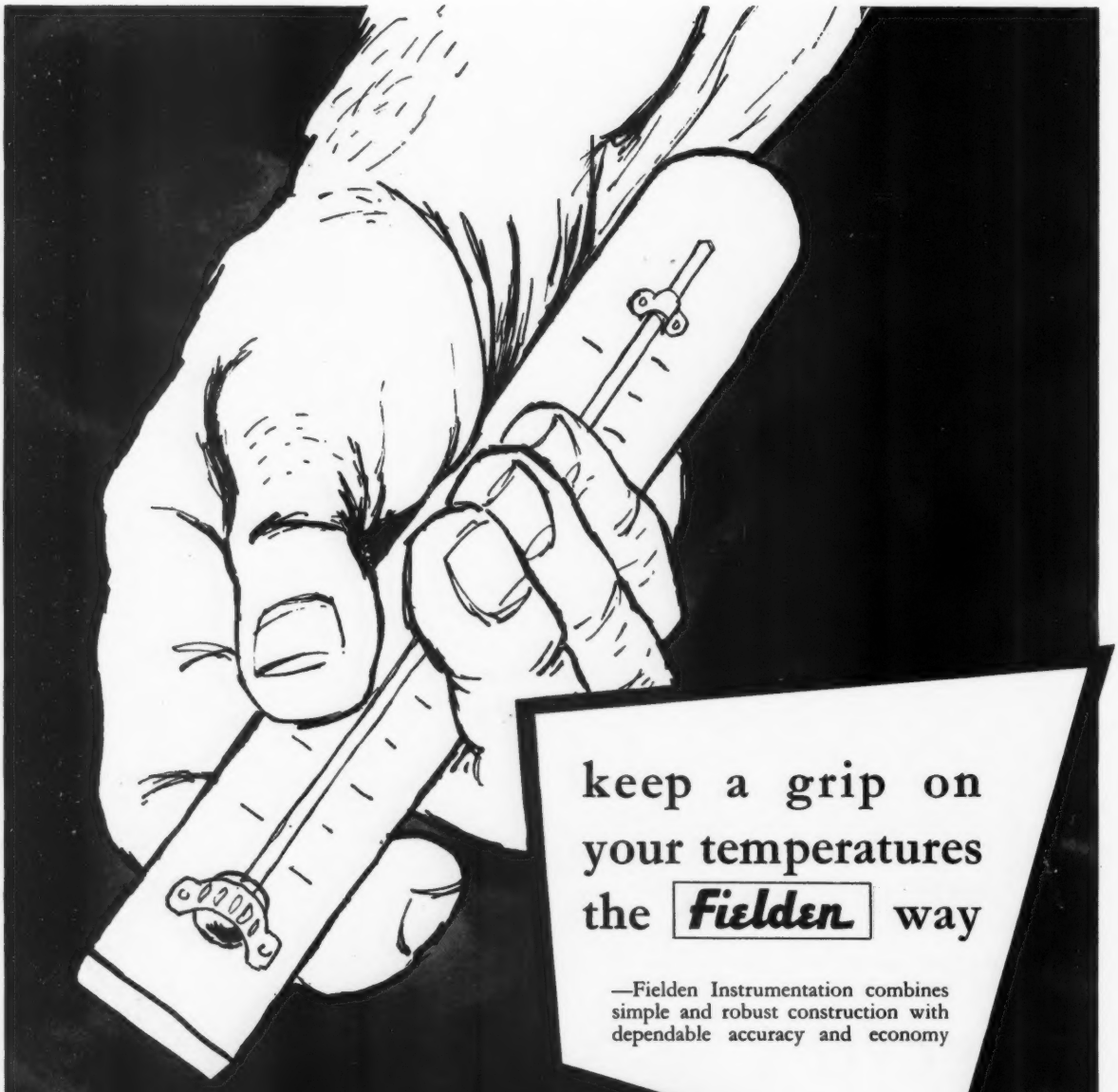

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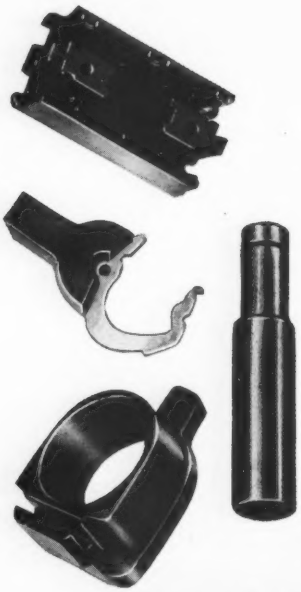

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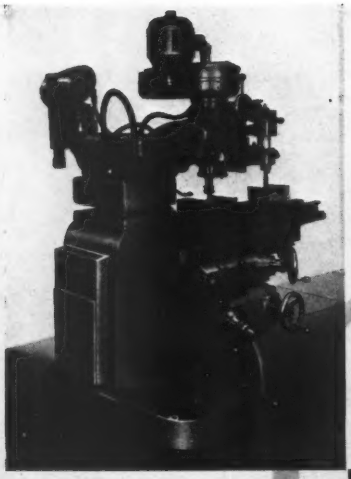

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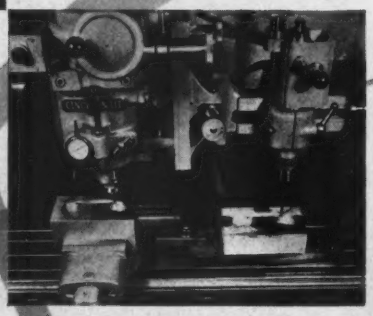

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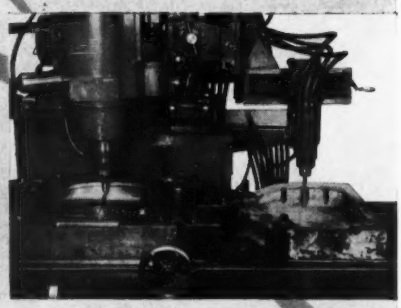

Milling a large die from a plaster master, on a **CINCINNATI 16" VERTICAL HYDROTEL.** Catalogue M-1773.

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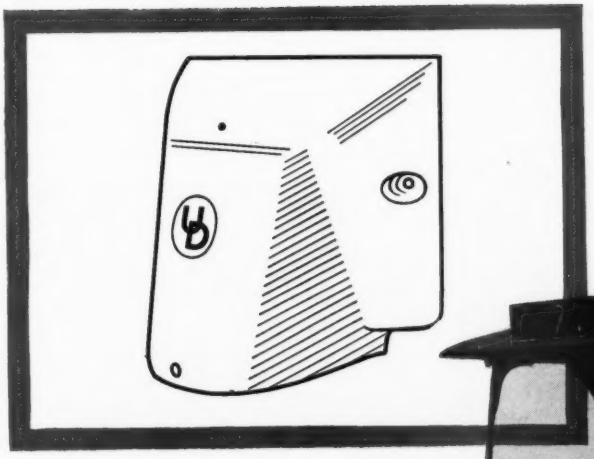
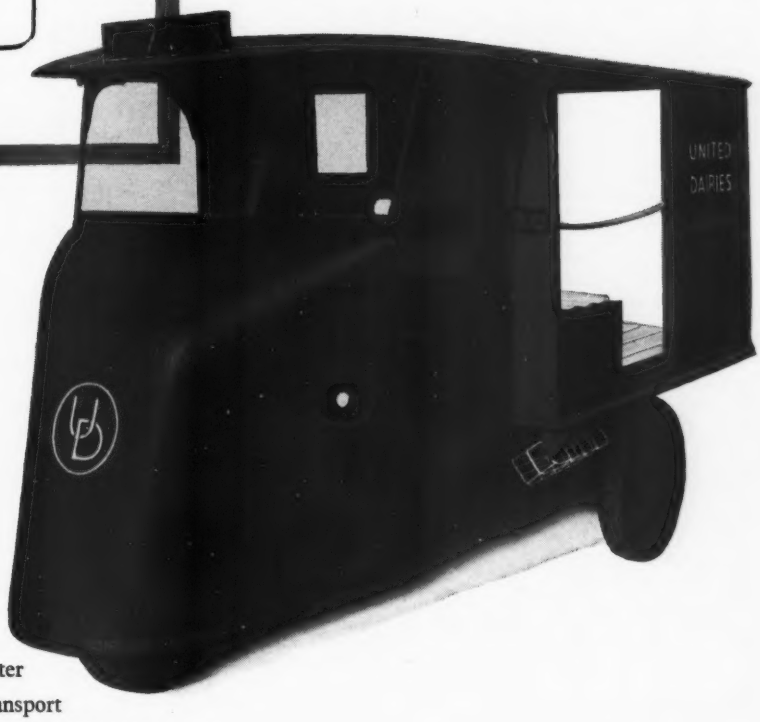


Turning them out TOUGHER



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Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

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EDITOR: M. D. CURWEN, B.Sc., A.R.I.C.
ASSISTANT EDITOR: C. W. WELCH

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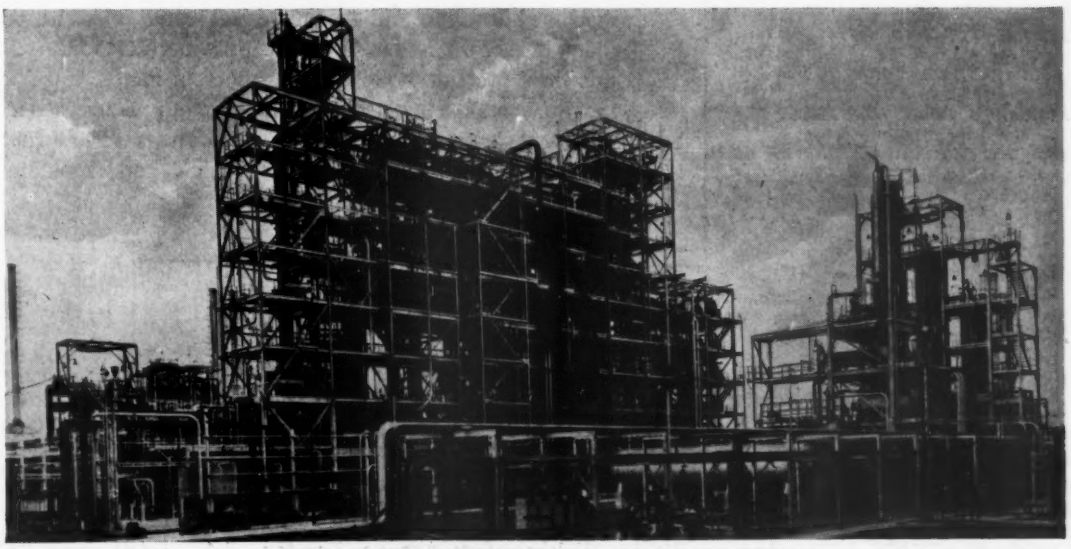

Olefine plant at the Wilton works of Imperial Chemical Industries Limited.

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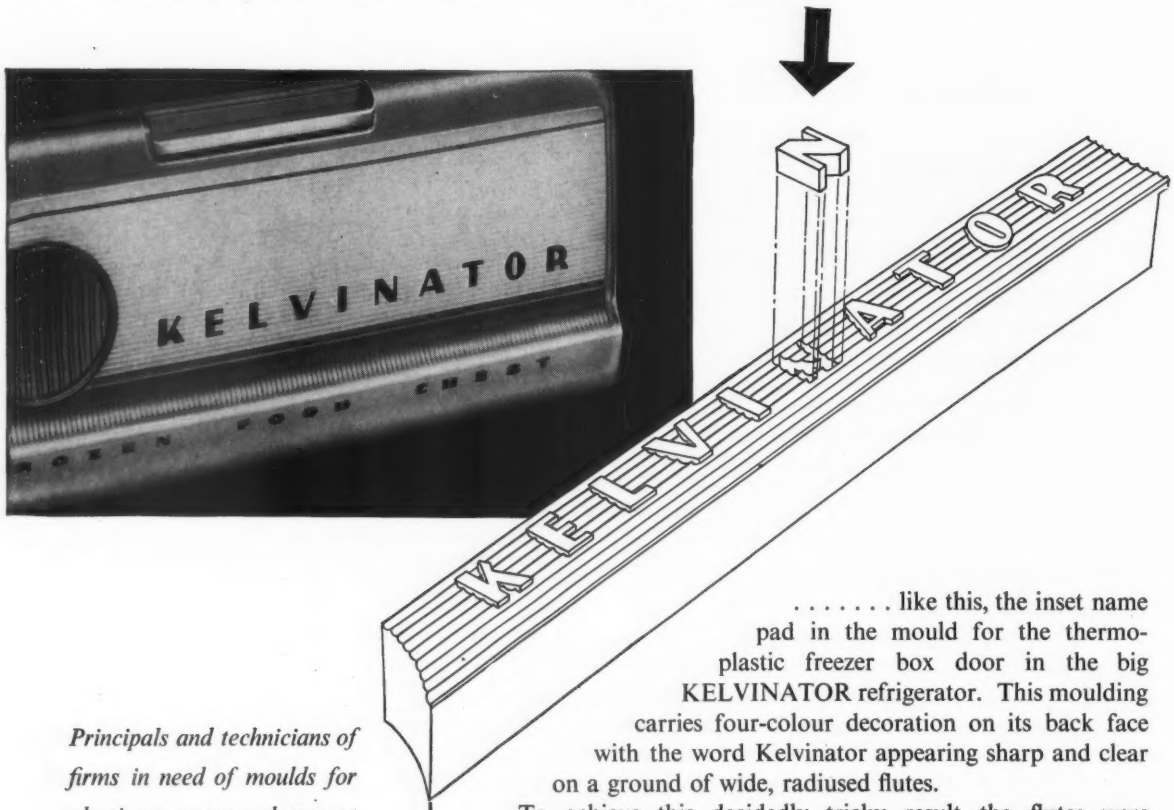


. . . . . like this, the inset name pad in the mould for the thermoplastic freezer box door in the big KELVINATOR refrigerator. This moulding carries four-colour decoration on its back face with the word Kelvinator appearing sharp and clear on a ground of wide, radiused flutes.

To achieve this decidedly tricky result the flutes were machined through and the individual letters were let into them, as shown in the isometric drawing. In addition to this there are side holes and an undercut handle involving moving cores on three sides of the mould, plus two alternative names to be accommodated on inset pads. The finished tool has produced some thirty thousand good mouldings weighing fifteen ounces apiece.

Principals and technicians of firms in need of moulds for plastics are very welcome at Avenue Works, to inspect the Tool Room and some of the mouldings made from tools designed and built there.

NATIONAL PLASTICS TOOLS

NATIONAL PLASTICS (SALES) LTD. Sales Organisation for BRITISH MOULDED PLASTICS LTD., Avenue Works, Walthamstow Avenue, London, E.4. *LARkswood 2323*

Plastics

VOL. XXI. No. 228 SEPTEMBER, 1956

EDITORIALS

Automation

THE future of many branches of industry in its most efficient form so far as can at present be conceived, lies in the application to production of self-acting and self-controlling energy-producing machines to perform specific operations, mechanical, hydraulic, pneumatic and electrical. The means of creating this new type of control has been brought about by the introduction of electronic systems which sense change, can amplify or otherwise alter energy demand or electrical characteristics and converts such results to required uses in the factory. Moreover, this new power and the speed with which it acts also give us the means to measure and control temperature, pressure, flow, viscosity, colour, quantity, thickness, etc., to a degree not hitherto obtainable.

Such is automation, a word which has been described as an ugly one for an exciting development. It is certainly an exciting one, for it means a rate of production of consistent quality materials and finished units or components far higher than has ever been achieved—it means also a minimum wastage, lower costs and the attainment of new standards of precision. It implies also a new standard of labour.

If the foregoing definition is ample there are at present very few factories so equipped, but whether the change to such a standard be rapid or not in fact, writers have indicated that the measure of our future will depend on the speed of change-over. Certainly the world's industries and its people are striving to understand its promises and its effects.

How far can the plastics industry proceed along the road to automation? This is almost too ingenuous a question for while to the economist outside the industry, its problems appear no different than those of any other in that raw materials are converted into finished units, components or other goods, yet there is a subtle and sharp divergence. We believe it to be one of the rare industries, in that the manufacturers of the raw materials, the makers of the machines and plant and the moulding industry which converts the materials by means of the machines and presses, are in closer combination than exists elsewhere. And since the first are products of the chemical industry and exceptionally complicated ones, both machine makers and moulders find themselves immersed in the problem of synthetic resins and in their chemical and physical characteristics.

Moreover our acquaintance with moulding compounds is short compared with traditional materials; their number, each of differing type, increases year by year, and the basic principles of our moulding methods are still in process of being evolved.

We know a great deal of what we want, but we certainly do not know all the questions relating to either the raw materials or to the machines.

If we speak of the synthetic resin section, we are face to face with pure chemical and physico-chemical problems and here obviously the impact of automation can be important. It needs no re-telling that of all the industries, chemical production has inevitably adopted automatic control because of technical necessity or as often as not because of special safety requirements. Thus the chemical industry and the petroleum industry has long regarded continuous processes rather than batch processes as ideal and long employed automatic control, in its earlier forms, for temperature and pressure measurement and recording, automatic weighing of solids, liquids and gases, control of movement of liquids and gases by flowmeters, etc.

The greatest use of electronic equipment here lies in the field of research and very few laboratories do not contain the necessary equipment for what may now be called ultra-rapid and ultra-sensitive analysis. Here the X-ray, infra-red and other spectrometers, polarographs, the new microscopes and the electrode systems which detect "acidity," all depend on electronics, and are common tools. In the factory the need for an integrated system which can electronically measure and control pressure, flow or feed level or changes in composition, viscosity, etc., is an attractive proposition, especially if they can be applied without risk to dangerous gases or low temperature conditions. The elimination of fires or explosions is also one of the results of such applications hoped for.

The Moulding Industry

CLEARLY implicit in the term automation is mass production which generally means production in line. Can we call our work mass production? If numbers in output is the sole criterion we certainly can, but while they are impressive they can prove deceptive, for continuous production of one type of job scarcely exists. It is rare because the customer orders only when he wants to and large storage capacity within the moulding shop is overwhelmingly difficult because of a second predominating factor: unlike most other industries there is exceptional complexity and diversity of production. A large shop at one given moment may be producing 20 or 50 mouldings, each completely different from one another in size, shape, material content and application, on very different machines. This, coupled with the increasing number of new plastics and the almost daily appearance of new applications, introduces a continual state of flux.

This is far from being an unhappy state. Indeed, it is largely responsible for the industry's virility and elasticity which is reflected in the rapid introduction of new methods and continually improved machines.

Some of the new devices have long been installed and most moulding shops possess electronically controlled pre-heaters which have greatly improved quality and speed of production during the past ten years. Some factories employ electromagnetic controls for the detection of metal impurities and X-ray apparatus for insert positioning, so that the claimed possibility of automatic feeding of inserts is doubly exciting. Beta-ray thickness gauges are employed in film and sheet production and electronic welding of p.v.c. has revolutionized specific sections. We have our example of complete automation in the p.v.c. dipping process and vacuum forming may follow suit.

Finally, how dearly we would want our inspection lines converted to automation!

Machines and Moulds

MUCH lies in the future of the machines and while the completely automatic press first appeared 20 years ago, it is rarely used for the reasons already given. New beginnings have now been made with electronically controlled time cycles. Much can also be done with new and controlled methods of feeding and especially with temperature control—control of the flowing plastic itself perhaps and not merely its metal contacts,

in both injection moulding and extrusion. Control of size of extrusions is also highly desirable.

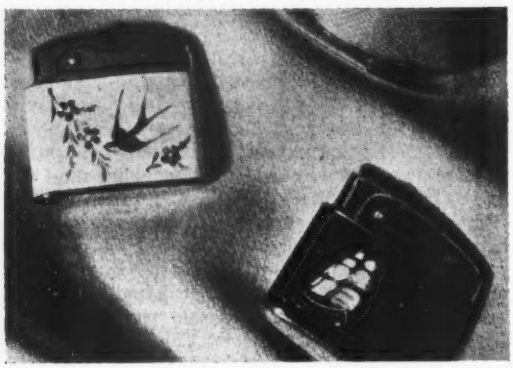
So far as the moulds themselves are concerned, this branch of the precision tool industry is one of the most promising for the application of electronic control. Much will depend on the entire economic set-up of the section for like any other system the new costly automation devices must " pay for themselves." But new precisions and new speeds of production are the promise here and both are fundamental to the health of the plastics industry.

If our industry is a complex one, we can at least see a little way ahead. In any case it may well be that automation will call the tune and design the pattern of our future. Who knows?

Moulding Powder and Shot

It Hits Britain 3125 B.C.

It's the same old story. We Britons, who clearly have more brains than anybody else in the world, can discover some new principle or invent a new process, but when it comes to developing it technically, the Germanii have got us beat. Now it's automation, and it's at least two snows agone that an Aurignacian from sunset way was telling me how to cut messages on runes with a flint instead of scraping for hours with my nails. And here am I, in my little cave on this summer day (there's a howling easterly gale blowing and sleeting outside as usual) trying to light a fire by rubbing two wet sticks together, to cook the leg of the mammoth I killed last week with a stone hatchet for my three wives and 48 starving kids. What a life! Now I find that somebody in Germany has invented a fully automatic lighter. You just flick the thingummy-bob at the end and before you can say " Prydain Son of Aed," your whiskers are alight. Of course we



won't get any in Britain for years as the Druids have ordered a freeze on capital expenditure. What a Government we've got! Anyway I don't suppose I'd be able to afford the gadget—it would cost at least six wolf skins and what with my corns, I can't go hopping about all over the place at my time of life. What am I talking about? Well, look at this picture that I've cut from an advert in the latest number of *Die Schaulade*. The caption under it is ' Zwei Pikkolofeurerzeuge für die Dame, *vollautomatisch* mit auswechselbarer Mechanik, in verschiedenen Oberflächenbehandlungen lieferbar.'

* * *

Tears, Bitter Tears

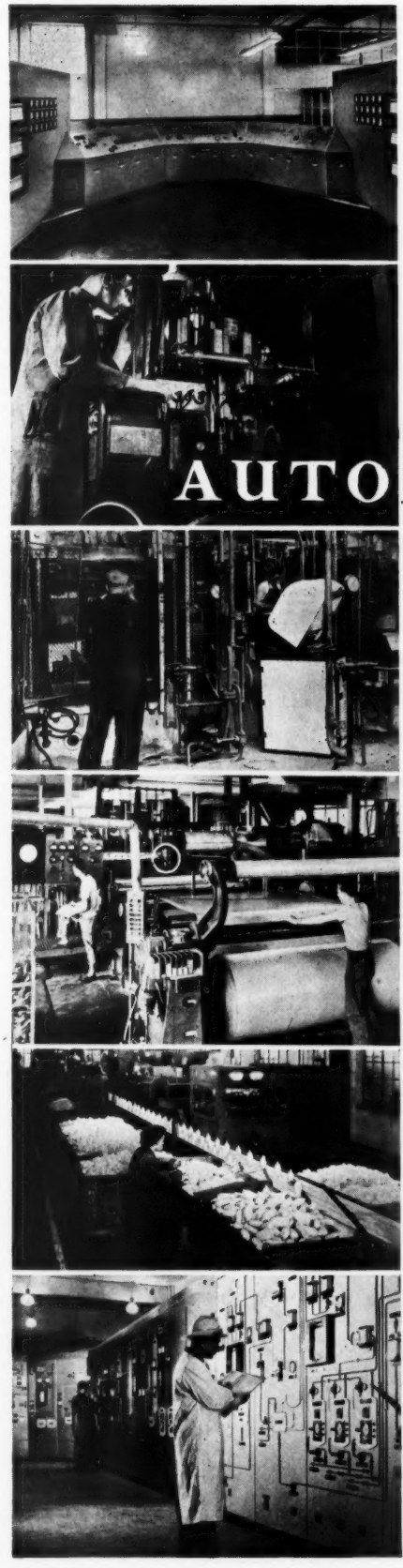
Is my face red ? I've received a slashing letter from David Radford of E. K. Cole Ltd. Without more ado, here it is. " Dear Dogsboddy, As I am sure you are aware, I am an avid reader of your well-known journal dealing with plastics matters, and it is not very often I disagree with your editorial, but I really must take you to task in respect of your remarks on Page 182 of your August edition. I was born and bred in Burton-on-Trent, Staffordshire, and it is for this reason that I write to you. I note you remark that a wave of bitter-sweet nostalgia pours over you, but this is nothing to the bitterness which is in my heart when you describe Burton-on-Trent as a ' tiny country hamlet '. It was a County Borough well before I knew it, over 50 years ago, and I really feel your remarks are most ill-timed. I would also respectfully remind you that it is quite impossible to see the High Street from the Station Hotel, as the Station Hotel is in Station Street, which joins High Street, but at least a mile away from the Station Hotel. Your facts, of course, are usually illuminatingly correct, but on this occasion you have slipped badly. Wishing your journal every success, I am, yours sincerely, David Radford, Executive Director, Plastics Division, Southend Factory." Well, I apologise to him and the County Borough Council. Note that I don't try to wriggle out of it by saying I was really thinking of Burton-in-Kendal or Burton-on-the-Wolds. Anyway, I bet Radford doesn't know that in 1953 there were 49,169 inhabitants in Burton, that early closing is on Wednesdays, that market days are on Thursdays and Saturdays, that there are 16 breweries and that in 1898 there was no such thing as closing time. Serves him right for not having been born in a wonderful age.

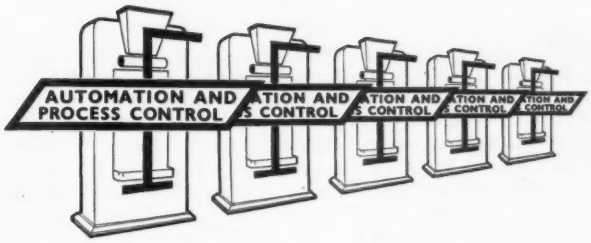
* * *

Vessels with Holes

In last month's issue I published a photograph of a " netted " polythene market bag I found in Italy; it has since been seen quite a good deal here, as a distributor is now importing them. Another example of the same form from the U.S.A. is in the shape of a laundry basket for the loading and hanging of wet laundry. The " net " type results not only in lightness but also obviously deals adequately with adhering water. The manufacturers, Columbus Plastic Products, Inc. of Ohio, have used Eastman's Tenite polythene for the job. No doubt we shall see other specimens of " netted " or perforated plastics more especially as technical applications. Their use in electroplating works is obvious and indeed perforated bucket-like structures in polymethyl methacrylate has been used for a number of years. Large rotating perforated structures of truncated cone form are often employed in the pickling industry for the treatment of small components (e.g. of cartridge cases) and both p.v.c. and polythene would appear to be more acceptable than the glazed earthenware used at present in their construction. Both stand up to the pickling acids well, including dilute nitric. Their size would probably mean their production by welding from sheet rather than by injection moulding.

DOGSBODDY.





AUTOMATION AND PLASTICS

THE descent on mankind of the implications of automation has had its impact as sudden and as great as the results and promises of atomic energy. This indeed is not astonishing since both spring from the same root, physical science, and therefore overlap. Just as we see atomic energy in two forms, one fearful and the other beneficent and productive of a new industrial force, a new means of delving further into Nature's mysteries, so do we see in automation two forms, one a danger or a blessing to our present man-labour structure and the other as a new means of fighting our industrial ills. Whatever our thoughts, we have no choice in this world but to make use of the new power.

Much has been written in general terms during the past months on its impact on industry. Little or nothing has been written on its more particular uses, possible and actual, within the plastics industry, and it is with the view of attempting to build a reasonably cohesive picture of the situation that we now present this special issue.

To the many manufacturers of the new devices and equipment and to the contributors on special subjects in this issue we offer our grateful thanks for their help which has been gratifyingly prompt and fulsome, and which reflects their deep belief in the application to our industry.

Here then, the reader will find articles on automation or other aspects of process control applied to most forms of moulding and fabrication, to compression and injection moulding, extrusion, vacuum forming, lamination, dipping, glass-fibre preforming and mixing, and in addition a fairly comprehensive review of the new machinery and equipment available.

Henceforth, like any other movement to raise our standard of production, automation becomes an integral part of the fabric of this journal.

Electronic Instruments in the Plastics Industry

By O. Heggs, B.Sc.(Tech.), and J. Wyatt*

IN the last decade the science of electronics has developed an increasing tempo and its successful application to instrumentation in industry has led to the coining of a word, automation, which has remained on the lips of laymen and technicians, politicians and trade unionists, executives and workers throughout the civilized world. Most of the (more often than not, heated) discussions on this topic have been concerned with the social implications of automation but in this article the authors will attempt to explore the subject purely from the point of view of production efficiency. Ten years ago it was difficult to visualise any electronic instrument controlling certain processes automatically, but now the pendulum has made a complete swing and very few processes appear to be beyond the pale of complete electronic instrumentation. In view of this, the article will describe certain instruments, selected from this huge field, which are of particular interest to the plastics industry.

The nature of this industry itself, in its diversity necessitates the application of a range of instruments to cover all processes from control in the raw material to the finished package.

The types of instruments which find a ready use in the plastics industry today are level controllers, temperature controllers and monitors, pressure transmitters and micro-measuring devices of all kinds.

One of the problems before plastic engineers has always been the efficient control of the level of liquids and powders in the large mixing hoppers used in this industry. To meet this type of requirement, Fielden Electronics Ltd. have produced an electronic level controller known as the Tektor.

The Tektor is not a depth gauge but rather an instrument to maintain level at any desired point in any kind of container, irrespective of shape, size or construction. It consists of a small electronic unit and a probe, the latter being inserted into the container. (See Figs. 1 and 2) The principle of electrical capacity

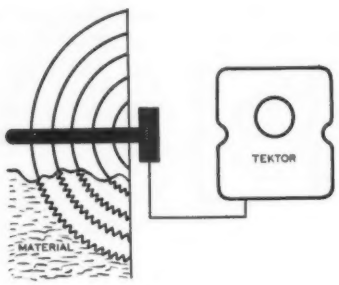


Fig. 1. Simplified installation diagram of the Fielden Tektor J level controller.

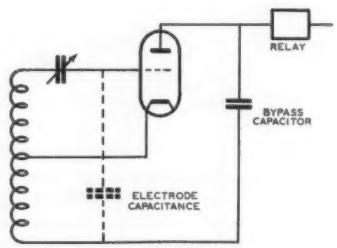


Fig. 2. Simplified circuit of the Tektor J.

is employed to detect the approach of any substance to (or recession from) the probe. The consequent change in capacity is made to actuate a relay which can switch on an audible or visible alarm or, stop or start a feeding mechanism to maintain the predetermined level in the container. For applications where the substance is electrically non-conducting, for example polythene chippings, the probe may be left bare. However, for conducting substances, the probe can be covered with a wide range of insulating materials, this not affecting the performance of the instrument. The main factors governing the choice of probe insulations are temperature, pressure and the material under measurement.

The Tektor has been used as a low-level control of feed hoppers on injection moulding machines and extruders.

This type of process demands that a minimum " head " of material should be kept in the feed hopper as failure to maintain this condition may result in a faulty product or loss of production in continuous processes. Fig. 3 shows a typical Tektor installation in which two instruments maintain a constant head of material in a feed hopper. As the material is drawn from the hopper and falls below the lower limit the Tektor will automatically start the feeding machinery and this will continue to run

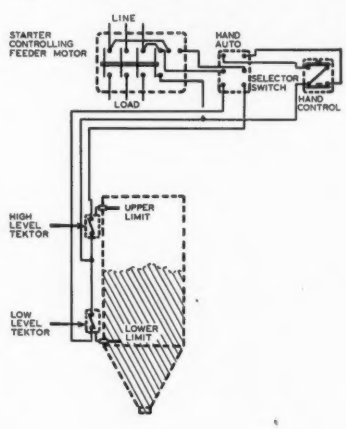


Fig. 3. Diagram of a typical Tektor installation in which two instruments maintain a constant head of material in the feed hopper.

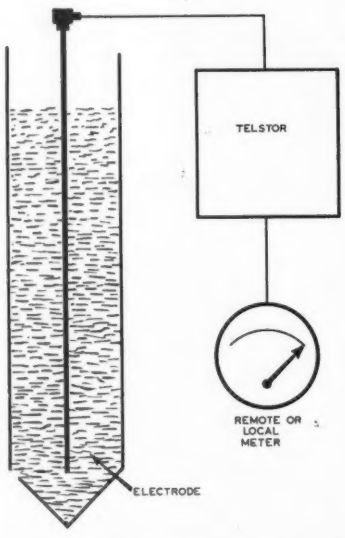


Fig. 4. A schematic diagram of a typical Telstor installation.

* Fielden Electronics Ltd.

until the material rises to the upper limit when the feeder is automatically stopped.

The more simple alternative is to use the Tektor J as a low level alarm and to prevent the extruder from operating in the event of failure of the supply of material to the feed hopper.

Another Fielden instrument for the measure of level, the Telstor, provides a continuous indication of the contents of bins, tanks, silos and any other kind of container of whatever shape, size or material. It can be applied to practically any liquid or free flowing solid almost regardless of viscosity, density, conductivity, insulating value, and in conditions of pressure or temperature removed from atmospheric. An added advantage of this instrument is that, in certain cases, the interface of two immiscible liquids may be followed, even in a sealed container and that the level variation may be measured either over the whole container or a very small part of it, as desired. The equipment consists of an electrode, an electronic unit in a die-cast metal case and an indicating meter. The electrode itself is a conductor reaching from top to bottom of the container and may be covered or bare as necessitated by the conditions. This probe is sensitive to changes of the material surrounding it down its whole length and the amount of change, representing the portion of the electrode covered, is noted by the electronic unit and shown on the indicating meter in the units required. As the material need not be in actual contact with the conducting electrode, it can be completely covered with anti-corrosive and heat-resistant insulation if the application requires, as in the case of acids, etc. A schematic diagram of the arrangement is given in Fig. 4.

Accurate control of the barrel temperature of the extruder has also been carried out electronically by Fielden Electronics with their Electronic Thermostat. This unit can be used either to provide warning of deviation from a required temperature or,

Fig. 5. Electronic thermostat for extrusion.

in those applications for which on/off control is satisfactory, to control the temperature at a pre-set level. The electronic equipment is housed in a small die-cast aluminium case, available for wall or panel mounting. A resistance bulb, with its pocket

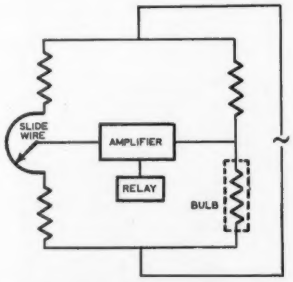


Fig. 6. Operating principle of the electronic thermostat shown in Fig. 5.

is inserted at the temperature measuring point and connected by copper cable to the electronic unit which is supplied from alternating current mains.

The front of the instrument (see Fig. 5) has a calibrated dial which is set by hand and indicates the temperature at which the operating point is controlled. The principle of operation of this instrument is extremely simple. An alternating voltage is applied to the bridge and the out-of-balance is amplified by a high gain, phase sensitive amplifier the output from which operates a relay (see Fig. 6).

As the action is on/off the precision of this instrument can only be fully employed where the thermal lag of the controlled system is at a minimum. For applications where there is appreciable delay in heat transmission between heat source and measuring element, other Fielden Temperature Control instruments are available providing proportional, re-set and rate action.

The Fielden Pyro-Servograph was developed to satisfy an outstanding requirement in the field of temperature measurement and control. Many who have realised the need for improved accuracy, greater reliability and more robust and powerful instruments to take the place of their present unsatisfactory equipment, have hesitated because of the cost of the electronic alternative. The Pyro-Servograph provides the solution—a powerful servo-mechanism, strong and trouble-free with adequate power for alarm and control functions and a repetitive accuracy of 0·5%. Simplicity of design drastically reduces the initial

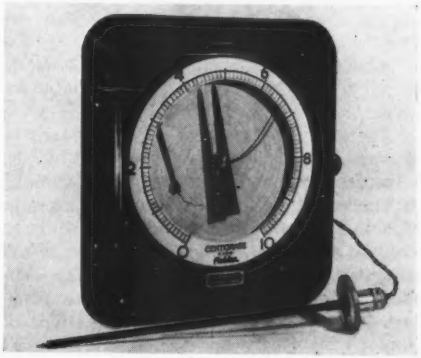


Fig. 7. Servo-mechanism as a recorder indicator.

cost and maintenance of this instrument. Fig. 7 shows an external view of this simple servo-mechanism as a recorder indicator. The output from the thermocouple is fed to a moving coil millivolt meter fitted with sprung jewel pivots. This moving-coil movement has the normal indicating pointer replaced by a light metal vane which acts as one plate of a variable condenser. Another similar vane, turned by the servo-mechanism, moves in the same arc as the meter-operated vane, the two vanes being maintained at a constant spacing by an electronic capacity relay which controls the servo-motor.

Any alteration in the spacing of the two vanes causes the electronic chassis in the instrument to notice the change in the relative capacity of the two vanes and to feed power to the pen driving motor, causing it to drive the follower vane in such a direction as to re-establish the initial positional relationship of the two vanes of the meter. The electrical capacity between them is restored to a predetermined value at which the electronic system is at balance and the motor at rest. At the same time, of course, the pen has made the necessary excursion of the recording chart, following and recording the change of position of the meter indication arm. (See Figs. 8 and 9).

A range of indicating, recording and controlling instruments of revolutionary design, covering temperatures from —200°C to +500°C, using platinum resistance bulbs is also produced by Fielden Electronics. The circuit is a special A.C. Potentiometer in which the sensing element forms one arm of a servo-operating self-balancing bridge. The unique design of these electronic

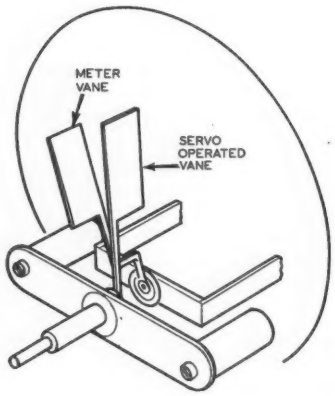


Fig. 8. Diagram showing the arrangement of the two vanes in the meter movement.

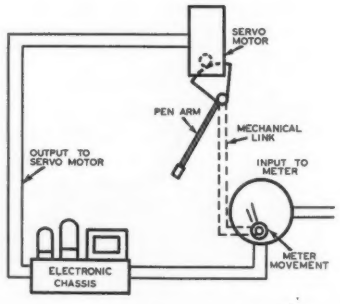


Fig. 9. A schematic diagram showing the servo-loop of the Pyro-Servograph.

resistance thermometers combines accuracy with simplicity and reliability. Single and multipoint instruments are available.

Perhaps a note about large scale scanning of temperature points would be of interest to plastics engineers. Although the instrument system described below was actually installed on a plant producing synthetic fibres similar problems arise from time to time in the plastics industry and the same type of solution could be imposed.

At the drawn twist stage of production of this particular synthetic fibre, it is absolutely essential that the temperature be carefully monitored and controlled. As over 2,700 temperature points were involved, conventional methods of temperature control and indication would have proved prohibitive, owing to the large initial capital cost. A separate indicating instrument on each point would have meant employing someone full-time, just to watch the temperatures, and, of course, the space taken up by such a number of indicators would have been extremely large.

However, when boiled down to essentials it was decided that, as long as all points were within the tolerances set for them, there was no need to indicate them. But it was necessary to have an alarm if any point moved outside its tolerance and, in that case, the actual temperature should be indicated. With this in mind, the following economical system was evolved.

In the system a relatively inexpensive thermostat is used to control the various points, but to scan them automatically a high precision instrument is needed to give the necessary alarms should a particular point be off control. Each machine has 112 heater plates arranged in two lines of 56, one line on either side. The thermostat and heater are in one unit which also incorporates the pocket for the thermocouple. An automatically driven scanning switch is connected to the 112 thermocouples through special compensating cables and the information from each thermocouple is given successively to the temperature indicating instrument via this motorised switch.

The system is arranged so that the 112 points are checked every 11 minutes and this gives a single point examination approximately every six seconds. The system operates as follows. The scanning equipment checks each point in succession continuously; provided each point is within the limits required, the scanning system continues to carry out its job of continuously checking. Should one point be outside the limits required a visual alarm is given and the automatic scanning switch stops at the point which is wrong and the instrument indicates the incorrect reading. It is necessary for the operator to restart the system by manually operating a push-button which, at the same time, cancels the visual alarm. The system is so arranged that this manual operation must be performed to restart the system after a fault and to ensure that the plant operatives take corrective action, should any alarm be given.

Vacuum forming is, of course, an operation of extreme importance in the plastics industry and the Fielden Low Pressure Transmitter, which was designed in co-operation with the Budenberg Gauge Co., of Broadheath, Manchester, offers a new and effective method of low pressure transmission. The pressure is allowed to act on a conventional diaphragm, thus producing a mechanical displacement sensibly proportional to pressure; thus this mechanical movement is directly coupled to the core of a differential transformer which converts the mechanical displacement into an electrical quantity.

The basic idea of the system is essentially extremely simple, a differential transformer being employed as the transducer. It consists of a primary and two secondaries, the two secondaries being connected in such a way that their outputs oppose and cancel one another when the core is exactly centralized. The slightest movement of the core disturbs the equality of the voltage derived from the secondaries, resulting in a differential output. The energy required to move the core in free space is negligible and does not disturb, in any way, the accuracy of the measuring element, so that a system is provided which is frictionless, completely accurate and virtually everlasting. Fig. 10 shows an internal view of the low pressure transmitter.

The diaphragm (which has been developed by the Budenburg Gauge Co., to give consistent accuracy with practically zero hysteresis) is coupled by a light rod to a small moving iron core. This is poised in the centre of a differential transformer by a frictionless suspension, which ensures that there is no dead spot, and every increment in pressure is transmitted with accuracy. Due to the extreme sensitivity of the differential transformer and the absence of friction, these units can be applied to pressure down to as low as 5 in. water gauge F.S.D., with perfect reliability.

It will be seen that the scope for instrumentation in the plastics industry is enormous; this article has covered but a small part of the field. Meanwhile, the science of electronics marches on and every day outmoded and unwieldy techniques are being replaced by simpler and more economical systems. The effect of this on the raising of production efficiency is surely self-evident and just as surely cannot be ignored by any progressive company.

The authors are indebted to Fielden Electronics Limited for permission to publish this article and for much of the material used.

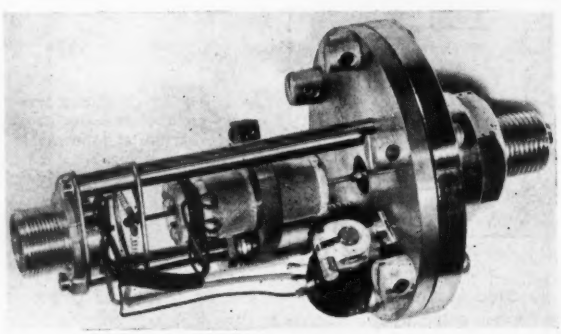


Fig. 10. Internal view of transmitter.

The Manufacture of Laminated Plastics by Automatic Control

By W. A. GOLDSTEIN*

THE production of plastics impregnated laminated materials can be divided into three basic manufacturing stages:—

(*a*) Synthesis of the impregnating resin.

(*b*) The impregnation of the paper or cloth base.

(*c*) Pressing of a stack of impregnated sheets into the finished product.

If a consistent product of satisfactory technical properties and appearance is to be produced, careful control of process variables is required at each stage. For this reason automatic control can play an important part in production, and this article describes some of the more usual control applications. As the manufacturing stages are clearly defined they will be dealt with under separate headings.

Resin Production

Resins used in the manufacture of laminated plastics are generally of the one-step type, produced by the reaction of phenol and formaldehyde, plus a catalyst. When the end point has been reached, water formed during the reaction is distilled off under vacuum. Spirit is then added to dissolve the resin.

The reaction is an exothermic one, and unless the temperature is carefully controlled, is liable to run beyond its end point, with the consequent loss or deterioration of product.

Temperature is usually controlled by varying the rate of steam or water flow to the jacket or coil of the reaction vessel. Remote operated valves are sometimes used to facilitate the centralization of control and, the operator can, by the rotation of a single dial, position all the necessary control valves to heat or cool the reactants. Alternatively, the remote operated valves are sometimes linked to a form of programme controller which operates them automatically in accordance with a pre-determined sequence.

Apart from temperature control of the reactants themselves, instruments are used to control the pressure during the distillation stage, the disposal of steam condensate from the reactor jacket, and the temperature of the distillation condenser; this last application effecting considerable economies of cooling water. Measuring and controlling equipment is usually centralized at an instrument panel as this facilitates plant operation. Typical examples are shown in Figures (1) and (2), the latter panel having a graphic diagram moulded on the face of a Warerite decorative sheet.

Impregnation

The next stage in manufacture is the impregnation of the paper or cloth base with the partially reacted resin. This part of the manufacturing process is a critical one, during which the resin undergoes further reaction to a carefully controlled limit. If the reaction is carried on too far, pressing will achieve insufficient adhesion between sheets, resulting in an unsatisfactory product. On the other hand, if the resin is under-reacted during the impregnating stage, the act of pressing will cause excess water, etc., to ooze out of the pressed stack, resulting not only in the production of unsatisfactory material, but also making it necessary to take the press out of service for cleaning.

Impregnation of the base paper or cloth is carried out in horizontal or vertical type continuous impregnators. The base material is passed under a dip roll, through a bath of resin solution. It then passes through rolls which squeeze out the excess resin, the compression between the squeeze rolls approximately controlling the quantity of resin solution transferred to the base. The impregnated base then passes through a long heat-zoned oven to effect the evaporation of solvent and the partial reaction of the resin to a predetermined degree.

It will be immediately apparent that two major factors govern the degree of reaction within the oven; i.e. oven temperature and paper speed. These factors determine the total heat which will be applied to the material at any point. It is obviously desirable to run at as high a speed as is mechanically practicable, in order to achieve maximum production. This speed may be limited by the quantity of heat which it is possible to apply in an oven of reasonable dimensions, as well as by mechanical considerations. However, it has not normally been found necessary to have any automatic control of speed, as the use of modern motor regulation equipment gives reasonably stable speeds without such control.

Impregnator ovens are usually steam heated, either by internal coils, external heater banks, or a combination of the two. In order to achieve accurate control of temperature, a temperature sensitive element is located in the air space of each zone as close to the paper as possible, its measurement signal, via a suitable controller,

* Bakelite Ltd.

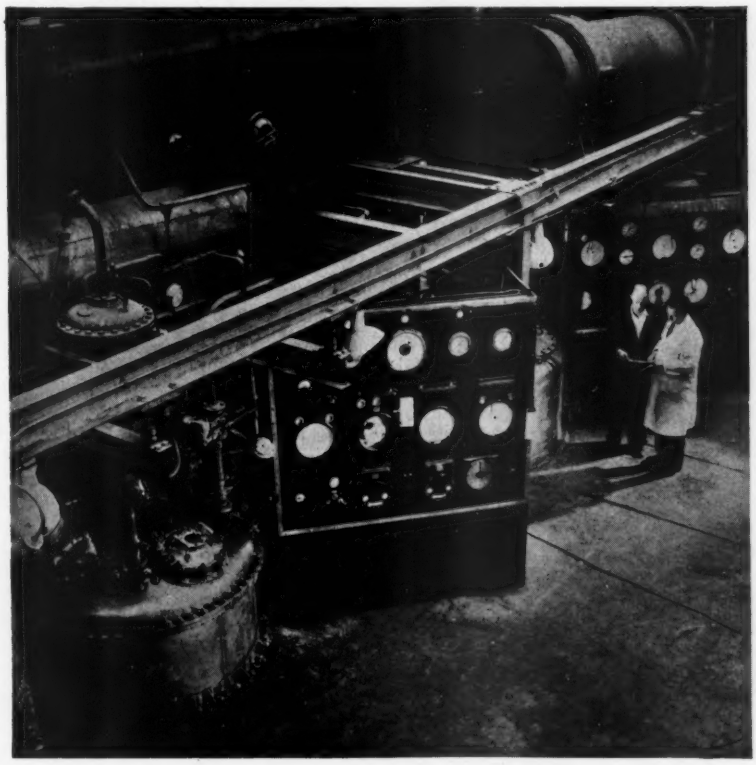


Fig. 1. Reactors for the manufacture of synthetic resins, control panels adjacent to each kettle.

varying the quantity of steam passing to the heater banks and/or coils. Pneumatic type controllers have proved to be the most generally satisfactory for this purpose and are used either in conjunction with thermocouples and suitable potentiometer recorders, or one of the relatively recent type temperature transmitters which have very small bulbs giving a speed of response to temperature changes comparable with that of a thermocouple.

Figure (3) shows the instrument panel of a typical horizontal impregnator, the panel includes not only the temperature controlling equipment, but also such items as steam pressure gauges and electrical controls.

Pressing

The final manufacturing stage, that of pressing the stacked impregnated sheets, is one in which automatic control can be of a fairly involved nature, as apart from conventional process variables, such as pressure, temperature and time, mechanical handling equipment of a more or less complex nature may be used in the manufacturing cycle.

Laminated plastics are produced in large multi-platen hydraulic presses, which are usually heated by steam or high pressure hot water. Such a press, with its associated control panel, is shown in Figure (4).

The variables which it is essential to control and which, if a consistent product is to be produced, must be accurately reproduceable, are:—

(*a*) Platen pressure.
(*b*) Platen temperature.
(*c*) Time of application of pressure and temperature.

To deal first with platen pressure, each press may have its own, self-contained, hydraulic system or, alternatively, a number of presses may be served by a single pump system and hydraulic accumulator. In the case of the former, it is customary to have two pumps, a low pressure one having a high capacity and used for press closure, and a high pressure low capacity one to build up to the working pressure and to maintain automatically that pressure against variations. Such variations can be caused by changes in the dimensions of the material, temperature changes, or slight leakages from the hydraulic system. It is usual to

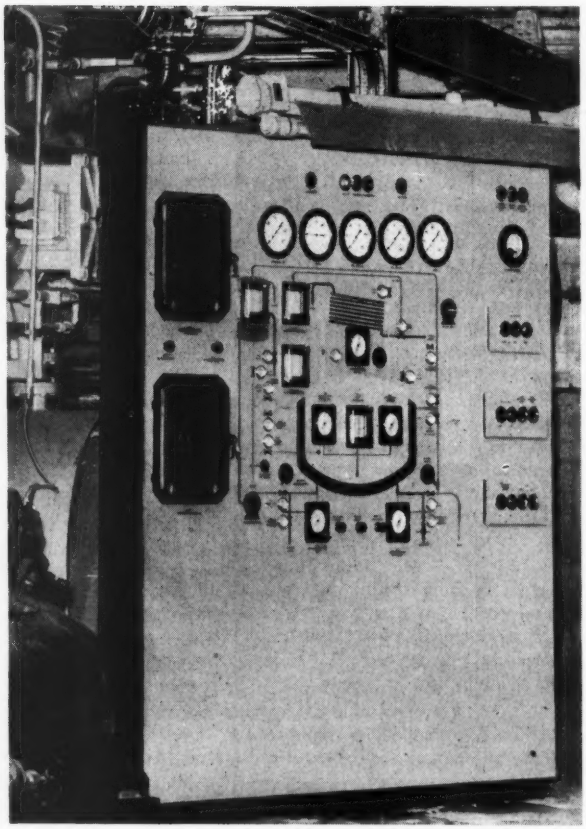


Fig. 2. Example of a control panel for resin manufacture. A graphic diagram is moulded on the face of a Warerite sheet.

sequence such pumps automatically so that both are started at once and the low pressure one switched off when it reaches its end pressure. In some instances, a third pump is introduced after the high pressure one, and is used solely to maintain the controlled pressure after this has been reached.

Automatic control of pressure in presses having self-contained hydraulic systems may be attained either by switching a pump on and off as required, or by running one continuously at an excess pressure and relieving the excess back to the pump suction by means of a precision relief valve. The latter method tends to give smoother control, but care must be taken to design the system to avoid over-heating the hydraulic fluid by recirculation. Switching the pump avoids this difficulty but results in slight variations in controlled pressure due to it being necessary to provide a " dead space " in order to avoid too frequent switching which can not only put an excessive mechanical load on the pump, but may necessitate considerable maintenance work on switch-gear.

Systems where a number of presses are supplied from a single hydraulic accumulator normally have a pressure-switch controlled pump on the main system and relief valves, where necessary, on individual presses.

Platen temperature control is attained by regulating the flow of heating or cooling medium in accordance with either platen surface temperature or the temperature of the medium leaving the platens. It is not normally necessary to control the temperature of individual platens but a multi-point thermocouple indicator is sometimes used to take spot readings both at each platen, and at various points across them.

The problem of accurate surface temperature measurement is difficult of solution and it is for this reason that the temperature of the heating or cooling medium leaving the platen is often the

Fig. 3. Instrument panel of impregnator.

controlled variable as it is possible to infer platen surface temperature from this with reasonable accuracy.

The basic system of control will be dependent upon whether steam or H.P. hot water is used for heating, but, if the former, it has been found useful, as has been mentioned in the case of resin reaction vessels, to use temperature controllers and control valves to discharge excess condensate. This method appears to be more effective on such applications than the use of conventional steam trapping. Again, as in resin production, the use of temperature control to limit the flow of cooling water during the cooling portion of the press cycle can effect appreciable economies.

Finally, we come to the overall control of the press cycle itself. Such a cycle can be divided into the following stages:

(1) Press Loading.
(2) Pressing—Heating Period.
(3) Pressing—Cooling Period.
(4) Press Discharge.

The cooling period is necessary both for process reasons and to make it possible to manhandle the finished product as soon as possible after discharge. In addition, if the press is steam heated, it will be necessary to include blow-down periods in the cycle between the cooling and heating stages.

It is possible to employ automatic sequence control of all or any of the above operations, although there will normally be points where the cycle is arrested until the press operator has, say, examined the load at a particular stage. A typical instrument for controlling such a sequence, and the duration of each stage, is shown in Figure (5). The central disc controls the duration of the stages, individual functions being controlled by the cams on the cam shaft. Such instruments are built of standard units and are flexible enough to permit their employment in press cycles of widely varying complexities.

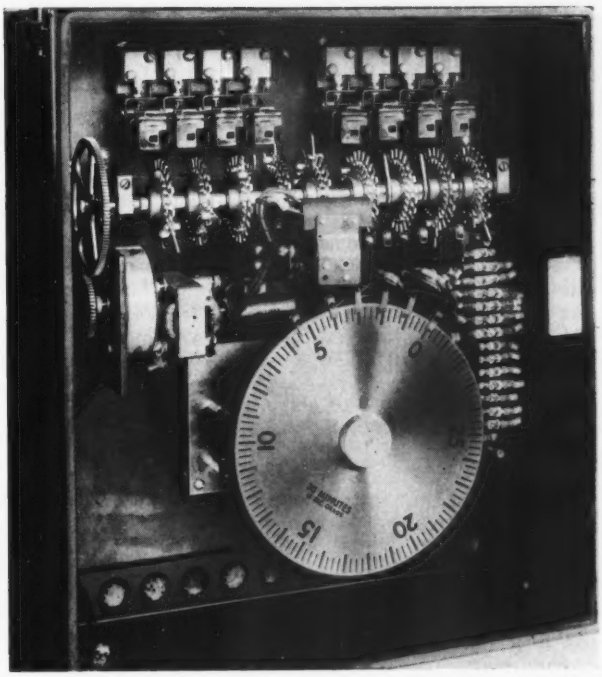


Fig. 5. Detail of a typical process timer.

General

From this brief resumé it will be seen that the employment of automatic control in laminated plastics production is extensive and the writer believes that the high standard the market now demands in such materials could not have been attained without the use of automatic controls. This is not to say, however, that the ultimate has yet been reached, as in a world of increasing competition it becomes more and more necessary to employ all possible means to increase production efficiency and product quality and to avoid wastage of high cost raw materials.

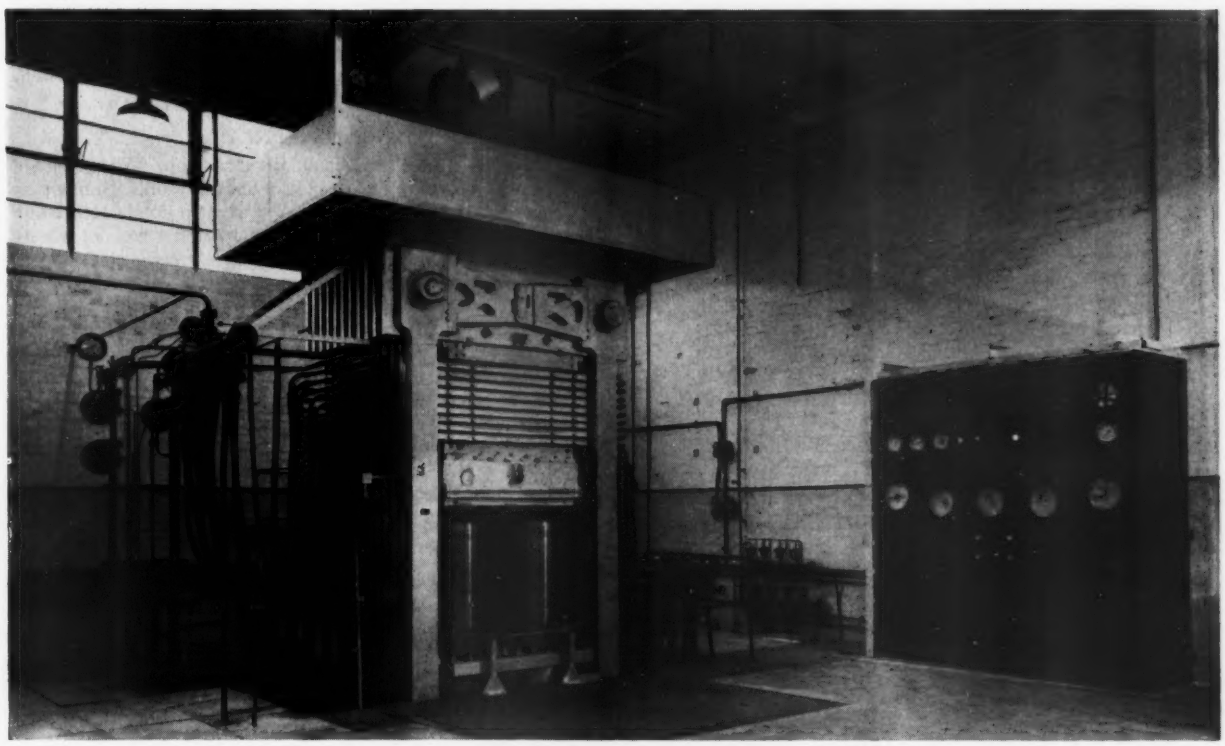


Fig. 4. Laminating press and associated automatic control panel.

Automatic Laboratories

Baird and Tatlock (London) Ltd., have studied the possibilities of automation in the laboratory, to conserve skilled personnel for important work. Progress in this field is briefly reviewed here

IN these days of increasing competition in both the home and overseas markets, all branches of industry are exploring every possible channel which might lead to increasing production, raising quality and above all, reducing costs. In this connection, the one most likely to bring these desirable features about is the field of automation, and indeed in some cases the automatic factory and the automatic office are already in existence. Because the laboratory stands behind the production line and controls the finished product, it is essential that the automatic laboratory shall be developed side by side with all other forms of automation.

Another problem facing industry today is the lack of qualified technical and scientific personnel. Routine laboratory processes are essential to large scale production but the expense to management of employing skilled and often highly paid scientists or technicians on routine work is not only uneconomic but prejudicial to future development. Technical brains can be employed more gainfully by being left free for original thought on future development.

Baird and Tatlock (London) Ltd., specialists in the manufacture of scientific instruments have pioneered the field of automatic laboratories and we give here brief details of the Analmatic laboratory, intended to take over from the scientist problems of routine analysis. The laboratory can operate continuously but it does not get tired so that the results obtained maintain a uniform degree of accuracy. On continuous working one B.T.L. Analmatic Laboratory could replace three skilled men each operating an eight-hour shift. In some instances, because Analmatic can do the work of more than one man, this factor may be increased.

Although Analmatic Laboratories have but recently been introduced they are already in service in different parts of the world. Experience of these has shown that the capital outlay involved can be less than the salary for a few months of a trained scientist capable of doing their work; maintenance costs are negligible.

Twin units for continuous analysis

An Analmatic Laboratory normally comprises one or more standard units which have each been developed to carry out a specific laboratory technique or to replace the muscular and thought processes of the human being generally employed to carry out such techniques. These units can be completely assembled, together with their power supplies and services, in standardized cabinets and interconnected in such a manner that the desired process is carried out and the result recorded without human intervention.

The illustration shows an Analmatic Laboratory designed to carry out continuous analysis of a liquor, sampled from four different sources, for a particular element. A measured volume of liquid sample is drawn from one of the sources in turn; to the sample is added measured volumes of two different reagents, after which the whole is reduced with hydrogen. Thereafter the liquid is examined in an absorptiometer and the result is recorded on a chart as concentration of the element in grams per litre of liquor. The recorder has two different ranges; the appropriate range is selected automatically depending upon the concentration of the sample being examined. The units forming these laboratories are as follows:—Left-hand bay: (a) Graphic panel which indicates by means of coloured lights the position of the mechanism at any given moment in the operating cycle. (b) Master control unit. (c) Sequence unit. (d) Time pulse unit. The last two units control all the operations of the laboratory and indicate faults if and when such occur. Means are provided for easily tracing faults. (e) E.H.T. supply unit for the absorptiometer which, in this instance, employs a photomultiplier. Right-Hand Bay: (a) Recorder unit. (b) Metering and mixing unit. (c) Absorptiometer unit.

Sequence Control Unit

This is the brain of an Analmatic laboratory. The sequence of operations is controlled from here but this is only the first part of its function. A more important part is to decide before any operation is started that the previous operation has not merely been completed, but has been satisfactorily completed. So at every stage the sequence control unit must receive a " feed-back " signal before initiating the next stage in the process. Another function of the sequence control unit is to provide information as to the stage in the whole sequence of operations at which the Analmatic Laboratory has arrived. This it does by illuminating a series of coloured lights on the flow diagram.

Working in collaboration with the sequence control unit is a fault alarm. When the sequence of operations is interrupted for any reason, or when any operation has not been satisfactorily completed, no " feed-back " signal will be received and therefore the next operation will not be initiated. At this point an alarm signal will be given both visually and aurally and the sequence control unit will stop all further operations until the fault has been cleared.

A fault-finding multi-point switch connects each main electrical circuit separately to a pilot light. With the aid of this switch the faulty circuit may be readily located.

The foregoing information touches only very briefly on the nature and scope of the automatic laboratory, but sufficiently to indicate the tremendous contribution that is made by the manufacturers of electronic equipment.

Automation and the Plastics Industry

By John A. Sargrove,* M.I.E.E., M.I.Prod.E., M.Brit.I.R.E.

THE Editor of *Plastics* has asked me to write a few notes on particular applications of automation which may prove of interest to the plastics industry, at least that part of it which does not concern the raw material side which properly belongs to the chemical and petroleum industries. (The writer believes that the Editor's interest in automation began when he examined in 1949 and reported in this Journal, the Sargrove ECME† process applied to the production of radio receivers by use of spray-metal coated phenolic mouldings.)

There are obviously numerous ways in which automation may theoretically be carried out in moulding shops but it will obviously entail close analysis to discover where and when such costly apparatus will pay. To begin with, there is a diversity of processes and some that technically bear little resemblance to others. Thus there is already in existence what might well be called an "automatic factory" for producing p.v.c. dipped hollow goods, with an electronically controlled sequence of heating metal moulds, dipping, curing by heat, cooling and finally re-cycling of the metal moulds back to the first station. This process, however, bears little resemblance to compression, extrusion, or injection moulding, although here too, especially in compression moulding, a high standard of normal electrically controlled automation was achieved before 1939 but is rarely employed for, strangely enough, economic reasons based on the present market limitations.

The writer believes that generally speaking, the production "runs" while comparatively large when calculated over the whole year are far from being always continuous, owing to spasmodic purchases by the customer. This would clearly militate against the ideal use of expensive instrumentation of the electronic type. Obviously this too would be the case in inspection which would otherwise prove a most fruitful field for the use of electronic devices, X-ray and photo-electric examination, whether for size, for the detection of metal impurities or metallic insert position or counting. More use could be made for instance of automatic feeding of metal inserts into a mould producing complicated electrical mouldings, although this would present its own problems, such as special jigs, etc. Nevertheless a good deal of automation is already in existence and is obviously very feasible for use in the large mould making shops.

In such a short article it is difficult to deal with many of these problems and their solutions. Thus it is preferable to give two examples only. In order to present first a comprehensive but very compact view of automation in action, and also because it is based completely on the use of plastic plates, acting as eminently mouldable dielectrics, it is hoped the writer may be excused in choosing the following example.

The Sargrove ECME Process

It is important to realize the difference between the Sargrove-ECME process and what are today termed printed circuits. The latter system is mainly a printed wiring made by etching away the copper foil which has been previously bonded to laminated plastic sheet. In this system, after the chemical removal of surplus metal which follows the photographic process, a multitude of holes are drilled through the remaining metal layer and standard components with wired ends are inserted from the reverse side. This assembly is then floated on to liquid tin with the components uppermost, and provided suitable fluxes are used, this process solders the components into place simultaneously.

The Sargrove ECME process is basically a different process. We start with a plastic moulding (Fig. 1) on which the grooves and depressions have been formed by the moulding tool which has been designed accordingly. The grooves and depressions as well as the through connecting holes and spiral formations represent the various parts of the circuit which will be formed

Fig. 1. Grooves and depressions are moulded-in, the moulding being a phenolic material. Metal is then deposited in successive layers to build up the required thickness, forming conductors and condensers and other terminations necessary to make a radio receiver when the pairs of plates are fitted together. The photograph shows the only skilled hand-work necessary the fitting of valves, loudspeakers, etc.

* Technical Director of Automation Consultants & Associates Limited.

† Electronic Circuit Making Equipment.

upon the plate. Grooves appear on both sides of the plate, the holes from the grooves are moulded through the plate and smaller or larger depressions are aligned on both sides to form a thin film of insulation, the condenser dielectric. Spiral grooves can also be on both sides representing tuning coils and other types of inductances, coupled together through the dielectric.

The Sargrove ECME machine (Fig. 2) was designed to accept these pre-moulded plates at the rate of one every 20 seconds. The moulded plates progress through the following processes without human intervention:

(1) The polished surface is removed by fine grid blasting so as to enable the sprayed on metal to adhere.

(2) Inter-stage inspection for quality of roughness and completion of removal of shiny surface.

(3) Molten atomized metal is sprayed on both sides covering the entire surface of the panel, in the grooves, depressions and the side of the through holes, thus connecting both sides of the panel in as many places as there are holes (there can be several hundreds of holes).

(4) Inter-stage inspection on completion of metal deposit.

(5) First face milling, removal of metal on the high spots.

(6) Second stage, removal of metal on both sides.

(7) Third stage, removal of all surplus metal revealing the panel and circuit completely. At this stage only the metal in the grooves and depressions remains. Here the condensers formed on both sides of the thin film of insulation are complete as a sandwich metal-plastic film, the metal being already connected *in situ* into the circuit wiring without any additional operation. The same applies to the coils which appear as metal deposits in the spiral grooves. The metal through the holes form inter-connections between the circuit on both sides of the plate as well as the holes for valve holder sockets.

(8) The panel now passes into the graphite spraying section where plastic mixtures of the same basic compound as that used in the moulded plate but mixed with carbon and graphite, etc., are sprayed on through stencils which are previously indexed on to the plate.
Different mixtures are used on each side so as to enable the designer to arrange convenient resistors having values of the magnitude of 100–10,000 ohms on one side and the other side having resistors from 10,000 ohms to 1 meg. ohm. The various resistors are formed by making masks or stencils with cut-outs having different aspect ratios (an aspect ratio means the ratio between length and width). Subsequent stages automatically test the deposited resistors, which in the example of the small Chinese radio-receiving set manufactured during 1947–48 numbered 16 on one side, but could well number many more.

(9) Valve sockets, etc., as single elements are automatically inserted into the assembly in which the previously metallized holes referred to above have been formed. They are finally automatically clinch riveted and fixed by a unique method of combined soldering and welding. There is no dip soldering and hence very little urge to cause the metal in the grooves to become detached.

(10) There is finally the overall testing stage in which any single defective plate is automatically rejected. If two or more plates have some defect the automatic inspection device automatically stops production and thus avoids the further production of scrap.

A point of interest is that by the ECME technique one can, without any further trouble, except that outlined above obtain:

(*a*) Inductances which are accurate to $\pm 5\%$.

(*b*) Condensers accurate to $\pm 5\%$.

(*c*) Resistors accurate to $\pm 20\%$.

The latter is adequate in most types of radio sets.

Fig. 2. The ECME Mark I plant, consisting of two process conveyors.

It has been possible to make at least one resistor on each side of the plate accurate to $\pm 3\%$. These are the two resistors used to monitor the graphite spraying process.

By using a new concept of a *flexible* moulding tool constructed somewhat on the " Meccano " principle it is possible to alter circuit configurations relatively easily. An ECME Mark II machine has been conceived which would be capable of a production output of the order of a quarter of a million to over a million sets per annum (depending on shift working) and these sets need not all be of the same type. Large parts of T.V. sets could be similarly produced.

In conclusion, the answer to the question why should one use the ECME process and invest in a more expensive plant than is required for the present day printed circuit (etched metal foil technique) can be clearly stated as follows:—

The circuit panel emerging from the E.C.M.E. machine contains all its small components, coils, condensers, resistors and even valve holders, made *in situ* by the machine and does not require these to be pre-fabricated in other factories. One should also not forget that these small components have to be ordered and transported to the assembly works where they are put into stock, tested again before use and then assembled (either manually or automatically) into the printed wiring.

The economies of the ECME system consequent upon the elimination of these human functions are very considerable and could lead to an appreciable cheapening of radio allied electronic equipment if used extensively in this country.

Automatic Control of Extrusion of Plastic Rods

With the increasing demand on the part of the customer for semi-finished manufactured articles, such as extruded plastic rods, tubes, etc., the earlier methods of casually extruding with an automatic machine without automatic control results in a good deal of wasted material. This is due to the fact that with a machine only occasionally controlled by a human being the many physical factors which influence the final product are not consistent and thus the rod diameters and surface finish vary appreciably.

During the last ten years or so considerable progress has been made in accurately controlling plastic extrusion. The following are the three main factors which have to be controlled:

(*a*) Precision temperature control of the extrusion die and the compression chamber immediately preceding it.

(*b*) Controlling the feed level of granular materials entering the compression screw chamber, so that the head of material entering here is as constant as possible. This is achieved by sub-dividing the hopper into two sections. The larger section, containing sufficient material to last several hours, is connected by a vibrating slope feeder with a very small hopper mounted on the intake orifice of the extruder body. This slope feeder does not vibrate all the time but is controlled in a stop-start manner by means of a photo-electric device looking into the intake aperture of the extruder and observing accurately a certain preset level on the extruder screw.
When this point becomes uncovered a glint of light is reflected into the photo-electric perceiver which via its amplifier immediately starts the vibratory feed bringing in the new granular material. When this part of the screw is covered the vibratory feed stops and only restarts again when its dose of granular material has been digested. It will be noted that this is a direct " Demand Actuated Control " and maintains an accurate feed of material into the plasticizing chamber, which consequently maintains a constant pressure in the extrusion head.

(*c*) Automatic guillotine devices which sub-divide the continuous extrusion into pre-set lengths. In this case again electronically controlled systems have been found most satisfactory as the pre-set lengths can be maintained accurately irrespective of variations in extrusion velocity. With suitable circuits which have been worked out many years ago, it is possible to control the exact cut length of rods even with multi-head extruders though the extrusion velocity in such multi-die systems varies from rod to rod. This same control device has also been made to actuate an ingenious automatic tipping and quenching device to harden cut lengths.
Whilst this country pioneered this system and a number of such fully automatic plants have been made and are in use in Britain; it is regretted that it fell to the Germans to fully exploit these electronic and control techniques in extrusion.

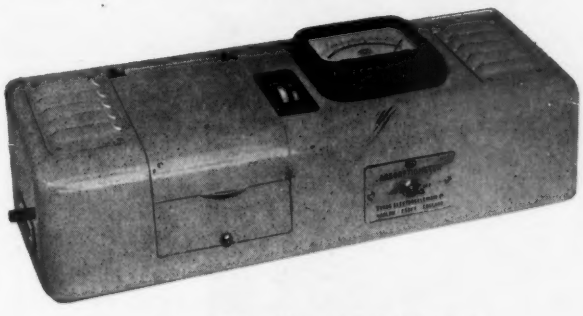
There are many other British developments of this nature that ought to be more fully exploited by the plastics industry such as cable covering, sheath diameter control, eccentricity control; electrical characteristic control; continuous monitor for completion of curing, etc.

However, there is increasing co-operation between the plant engineers and others concerned with production equipment and the development technologist which give hope for the future in improving the consistency of the product and the reduction of production cost. This should show a benefit all round.

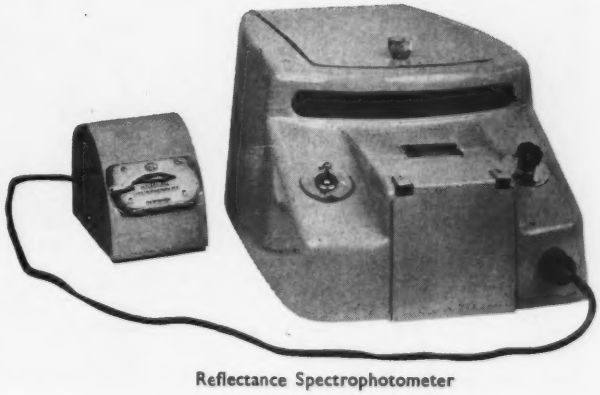
CONTROL EQUIPMENT

THE routine estimation of the colour of any flat surface is a frequent process in the plastics industry. Evans Electroselenium Ltd., Harlow, Essex, manufacture a reflectance spectrophotometer which incorporates nine filters conveniently mounted in a wheel to provide a ready means of measuring the percentage reflectance throughout the spectrum.

Another piece of equipment made by the same company is a long cell absorptiometer, embodying the use of the photo-cell. Absorptiometric analysis is now widely employed, eliminating the human element by providing accurate scale readings.



Apparatus for Absorptiometric Analysis



Reflectance Spectrophotometer

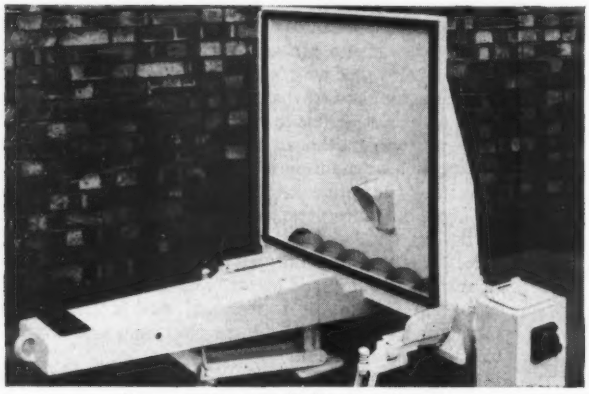
Bulk Materials Handling

A method of reducing handling costs in the movement and storage of moulding powders

IN the course of a year the average-sized moulding shop may handle as much as 1,000 tons of moulding powder; most of it will be delivered in 56 lb. sacks. Some 40,000 sacks will therefore be brought into the factory, moved about during storage, and finally passed into the moulding shop for use.

The problem is not, of course, as great in the plastics industry as in many others. Cement and sugar are examples of very large scale material handling, and it is as a result of investigations in these industries that a system has been developed which will interest many in the plastics industry.

The photographs on this page explain clearly the Tote System



Screw type gravity discharge equipment.

for bulk handling. Pressoturn Ltd., of Leamington Spa, manufacturers of the equipment in Great Britain, are in the process of installing the Tote System at the premises of one of our biggest plastics companies, and very significant savings in handling costs are one of the chief reasons for this installation.

The main advantages of the system may be summarized as follows:—(1) An economic method of bulk handling and storage. (2) Complete product protection. (3) Elimination of product loss and wastage. (4) Elimination of the expense of providing and replacing expendable containers. (5) Enables storage space to be used to maximum capacity.

In the moulding plant mentioned above, large quantities of standard colours are employed, general purpose phenolics in blacks and browns. The Tote bins, made of aluminium, are filled at the works of the moulding powder manufacturer, and taken by road to the moulding plant. Off-loaded by fork lift trucks, the bins are then stored, the contents being drawn upon when required. The contents are safe from any damage, particularly contamination by dirt or moisture.

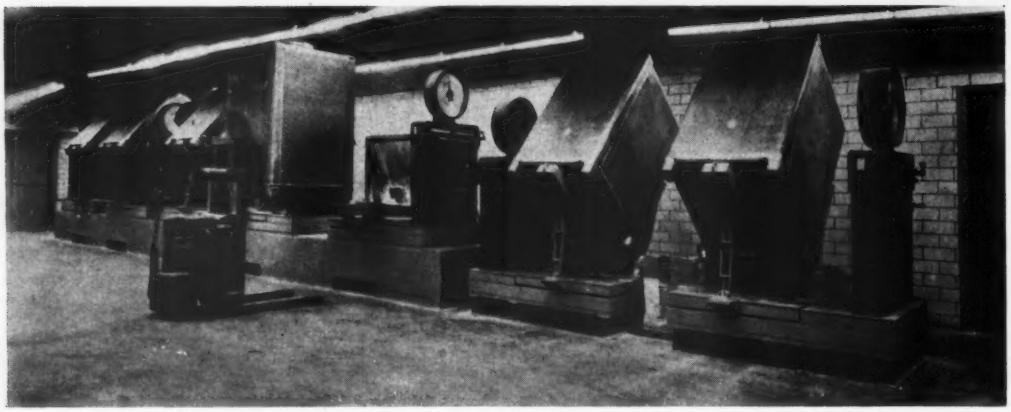
It will be seen that the transfer of filled bins from stores to road vehicles, and from road vehicles to receiving depots, can be accomplished in a fraction of the time needed to move equal quantities of bagged materials. As an example, the time taken to unload one 6-ton vehicle of bagged powder was three man hours. The same vehicle carrying six Tote bins containing an equal quantity of powder was unloaded in eight minutes.

The Tote bins are manufactured in three sizes, 42 cubic feet capacity, 74 cubic feet, and 110 cubic feet. The following figures provided by Pressoturn Ltd., will be of interest, comprising the floor area and cubic capacity employed in the storage, by various means, of 22,400 lb. of powder.

	Paper Sacks	Bulk Hopper	Tote System
Floor Area ...	124 sq. ft.	98 sq. ft.	84 sq. ft.
Cubic Volume ...	702 cu. ft.	955 cu. ft.	483 cu. ft.

In America, the National Plastics Co., of Odenton, Maryland, has installed the Tote system with apparent success. Bulk discount from the material supplies due to elimination of disposable containers, no product contamination or wastage, and reduced warehouse space are amongst the results claimed.

(Above) Bulk transport of moulding powder with standard flat vehicles.



Powder blending with the Tote system. Two bins feed into one blender. A view of the Tote installation at the Cleveland, Ohio, moulding plant of the General Electric Company.

Process Control for Compression Moulding

Two Bradley and Turton presses, one only just announced, are equipped with the latest process control instruments.

A VISITOR to the recent plastics exhibition in New York commented on the absence of automatic compression moulding presses. One or two were shown, but generally progress was small.

This is not surprising, in the sense that formidable problems

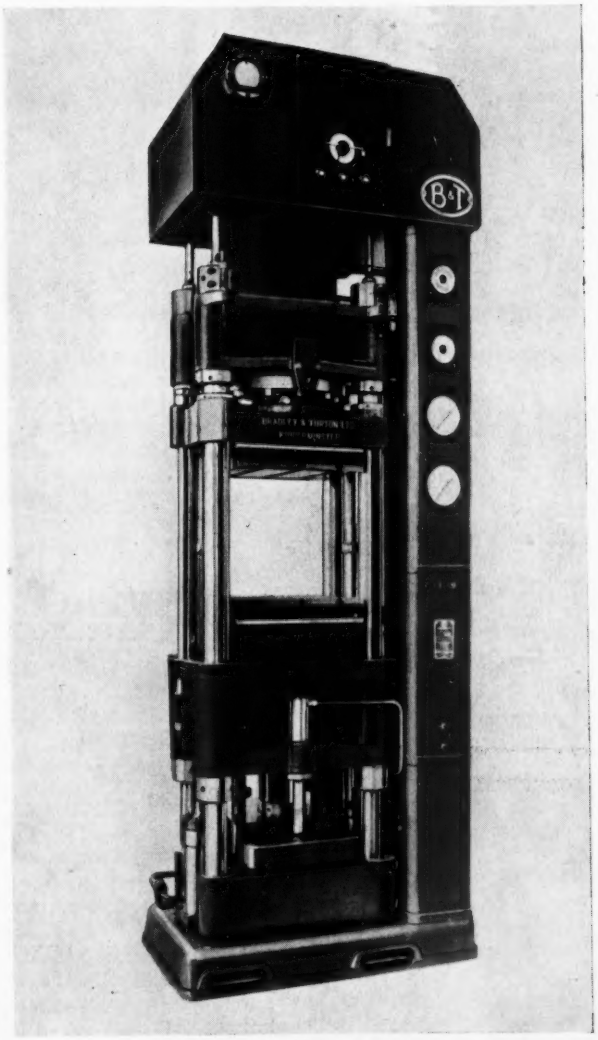


Fig. 1. Bradley and Turton down-stroking press.

confront the designer of a fully automatic compression press. Much of the work such a press would have to handle would be in the electrical field, and this immediately pre-supposes the use of inserts. The sheer mechanics of automatically loading anything from 1 to 50 or more small inserts, arranging that they are exactly in position, by any truly automatic process, is no doubt possible, but of doubtful economic value. Cost and maintenance alone would place a heavy restriction on the commercial exploitation of such a system. In addition, such presses would be limited to repetitive mouldings of long runs; theoretically such conditions should be common in the plastics industry, but in practice few tools are in the press long enough to bring them within the compass of the fully automatic machine. Whilst the total run on any one tool may be very large, actual production is usually broken down into short periods at intervals over the year. This is not the result of inefficient planning since the customer can usually only take a limited quantity of mouldings at a time, and the moulder usually lacks the storage space that would be necessary if all contracts were to be effected in one run.

However, considerable progress has now been made towards near-automation, although for rather different reasons from those generally associated with the word " automation." In no way primarily designed to replace men, the semi-automatic machine is the outcome of many years of planning, to eliminate as many variables as possible in the moulding process. The advantages of the semi-automatic press may be summed-up as follows:—Conditions for each cycle are exactly reproducible in terms of time, heat and pressure. From this follows the maintenance of high quality products, the elimination of much of the human element, the reduction of faulty mouldings, and the possibility of one operator working more than one press.

For the purposes of this special issue of *Plastics* we spent some time at the Kidderminster works of the well-known press manufacturers Bradley & Turton Ltd., observing two presses in operation, the larger 536.U/1–150/35 ton and the smaller upstroking machine, designed for fast cycling work, the 501.W/1–25 ton. Both presses incorporate process controllers, the key part of any semi-automatic press.

Fig. 1 shows the 536.U/1 press from the standpoint of the operator. It is designed for compression and transfer moulding and follows normal design practice so far as the moving parts are concerned. Its special features are contained within the panel on the right of the press main frame, and in the enclosed space over the main cylinder. Figs. 2, 3, and 4 provide close-up views of these parts of the press.

Fig. 2 shows the process controller, in this case by Bristol's Instrument Co. Ltd., the core of which is a system of 11 rotating cams. To each of these cams can be fitted a number of dogs, each capable of initiating or terminating a specific movement of the press. Each cam is graduated 0 to 100, so that the speed of rotation of the cams, combined with the spacing of the dogs, enables precise settings to be made. Thus a complicated series of operations can be infinitely repeated. The setting of the dogs

Fig. 2. Bristol process timer on press.

is comparatively simple, and can be recorded, for filing purposes, on card systems. Only the setting number for each cam need be noted to give a permanent record of each moulding to go through the shop.

Fig. 3 shows the dial instruments. The two at the top are the temperature regulators for the top and bottom platens. The lower two are pressure gauges for the closing cylinder and the transfer/ejector cylinder.

Shown in Fig. 4 are the manual controls for the closing cylinder and the transfer/ejector cylinder, and these controls can be used for tool setting. Normally none of these controls will work whilst the guard is open. The guard, shown in the open position in Fig. 1, is of the vertical type and is operated by the process controller when automatic cycling is employed.

The press is designed for push-button operation, the operator simply loads the material and presses a button. A typical transfer moulding sequence is as follows:—

1. Press start button.
2. Guard closes.
3. Closing ram and top platen descends.
4. Closing ram builds up to set pressure.
5. Transfer ram rises.
6. Cure period starts.
7. On completion of cure period, closing ram returns.
8. Guard opens.
9. Transfer ram ejects.
10. Press button.
11. Transfer ram returns—
12. Ejector lowers.

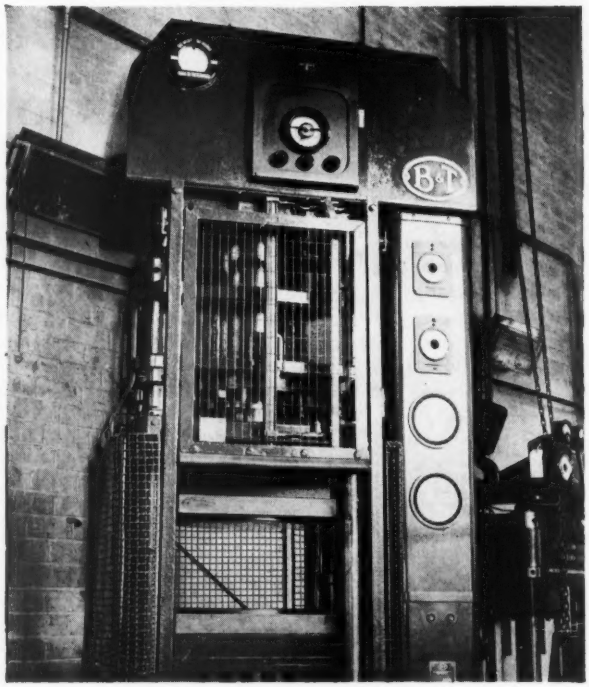


Fig. 3. Main instrument panel.

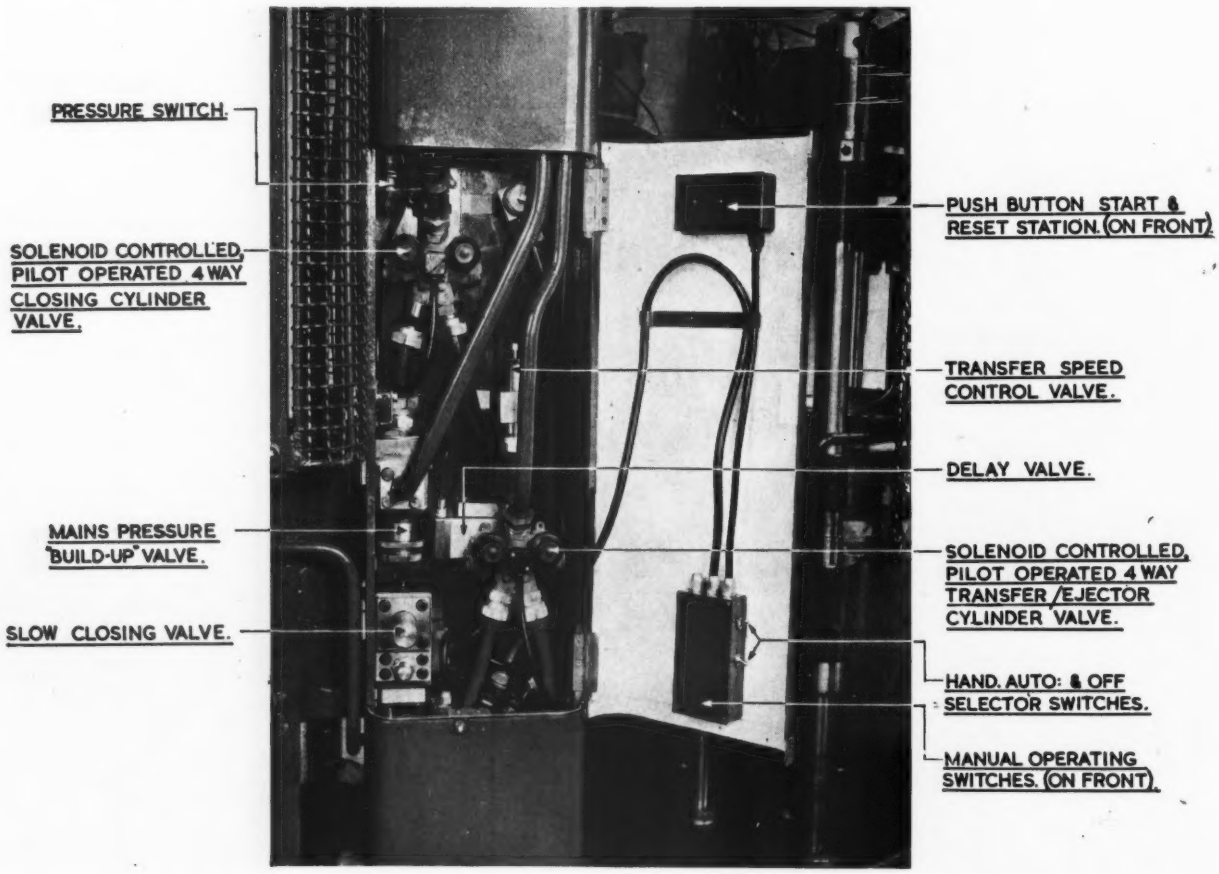

PRESSURE SWITCH.
SOLENOID CONTROLLED, PILOT OPERATED 4 WAY CLOSING CYLINDER VALVE.
MAINS PRESSURE "BUILD-UP" VALVE.
SLOW CLOSING VALVE.
PUSH BUTTON START & RESET STATION. (ON FRONT).
TRANSFER SPEED CONTROL VALVE.
DELAY VALVE.
SOLENOID CONTROLLED, PILOT OPERATED 4 WAY TRANSFER/EJECTOR CYLINDER VALVE.
HAND. AUTO: & OFF SELECTOR SWITCHES.
MANUAL OPERATING SWITCHES. (ON FRONT).

Fig. 4. Detailed view of manual controls, normally enclosed by metal door which can be locked.

All of the above movements, except 1 and 10, are initiated at pre-set times on the cams of the process controller and can only be varied by an authorized person who has access to the controller. The duration of each cycle is therefore fixed, and the possibility of under—or over cure is eliminated.

Compression moulding cycles including " breathing " and " dwell " are very easily set up and regulated by the process controller.

25-ton Upstroking press

Fig. 5 shows this press complete with electrically heated platens and operator guard. Designed for fast cycling, it is very suitable for use with alkyd moulding compounds. This machine has a process controller designed and built by Bradley & Turton Ltd. incorporating a Burrell multi-point process timer.

A fixed disc is provided on each instrument to denote the elapsed time from the commencement of the cycle. The variable periods are pre-set by moving knurled friction discs (which are graduated on their peripheries) against vernier scales, these latter have also provision for indicating tabs to denote the operation controlled by the adjacent discs. The mechanism is driven from a self-starting synchronous motor and operated by a magnetic clutch which when de-energized allows the timer to re-set ready for the next operation. The whole is contained in an aluminium case with hinged, glazed front panel provided with lock and key.

Operation is by push-button with " start " and " re-set " pushes or alternatively the press cycle of operations can be initiated by simply closing the operator guard.

High closing speed is a feature of this press, with an adjustable slow speed for the pressing operation.

Provision is made for " inching " when the controls are manually operated for tool setting purposes only.

It will therefore be seen that in constructing these different types of press Bradley & Turton have at present worked towards process control with the object of improving the quality of mouldings rather than full automation. The use of the semi-automatic equipment does not eliminate the operator, but it does provide opportunities for an operator to service more than one press under certain conditions.

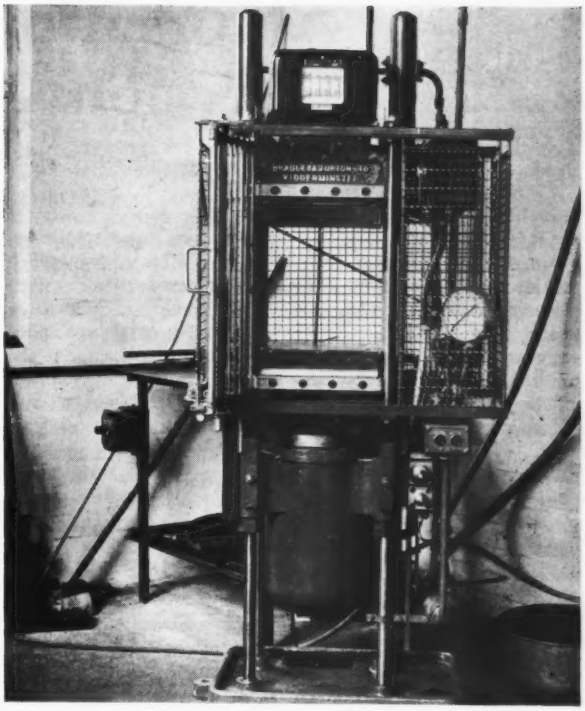


Fig. 5. 25-ton fast cycling press.

More comprehensive information on these two machines will be given in our " Machines for the Industry " article next month.

Improved Productivity in the Vacuum Forming Process

IN the course of the last three years frequent mention has been made in *Plastics* to the vacuum forming process. Like many other methods of fabricating plastics, it was inevitable that methods should be studied to make the process repetitive and fast. This is particularly necessary if vacuum formed thermoplastic sheet is to be widely used in packaging.

One of the machinery manufacturers specializing in the construction of vacuum forming equipment has now produced a model, AUT.30/30, which is fitted with a roll feed cabinet for continuous bubble pack production, and which utilizes thin-gauge thermoplastic sheet in reel form.

This machine utilizes sheet 26 in. wide, on a moulding area of 26 in. by 26 in. The reel is loaded into the feed equipment, and fed across the mould. Process timers in the control panel determine the dwell of the heater over the film and the period of evacuation. The machine is fitted with dual controls for the manual operation of each sequence in the cycle for experimental purposes.

It will be seen that key parts to this equipment are the process timers. In other words, the cycle is set to certain times, and is thereafter repeated to exactly the same periods. Given correct setting, the possibility of overheating is eliminated, and production is much more accurately controlled.

As an indication of productivity, dry cycling on the full moulding area is 600 cycles per hour, employing cellulose acetate.

Continuous forming of bubble packs with the Latymer AUT. 30/30 machine.

Automation in Injection Moulding

By L. GRIFFITHS, B.Sc.*

A review of present trends and limitations

AUTOMATION is hardly a new concept in the injection moulding industry. The very first machines displayed a considerable degree of automation and subsequent development has been continually in the direction of fully automatic operation. It is now no longer uncommon to see batteries of high speed automatic machines under the control of one operator. The result is increased productivity of the worker and increased moulding efficiency, since consistent quality is a natural consequence of successful automatic injection moulding.

The attractions of automatic working are so obvious that a host of questions immediately arise. For instance, why has it taken so long to reach fruition? Is it universally applicable, or are there limitations? What is the present trend in the industry? The answers to these questions become more evident when the general technical requirements of the process are surveyed.

Semi-automatic machines performing one cycle of operations by auto-mechanism have been available for many years, and their modification to give continuous automatic cycling has never presented great difficulty. However, for some considerable time, the facility was not offered by machine manufacturers as, without consideration of many other features, it was not only useless but liable to cause mould damage. Successful automatic working demands complete consistency at every stage of the process, together with adequate mould design, and safety devices to stop the mould closing upon any broken piece of moulding or flash.

Mould and Product Design

The design of product and mould immediately determines whether automatic working is feasible. The moulding(s), together with any sprue or runners, must be completely ejected when the mould opens, and be dropped or thrown clear of the mould faces before it closes again. Meeting this primary requirement is the factor which ultimately sets the limit on the field of automatic working. So far, the greatest success has been achieved with small parts of fairly simple shape and without the complication of inserts. The combination of sprueless moulding (single impression) or hot runner moulding (multi-impression) with fully automatic working represents the highest pitch of present day achievement. This permits rapid cycling, eases the ejection problem, and frees the operator from the job of re-using sprue and runners.

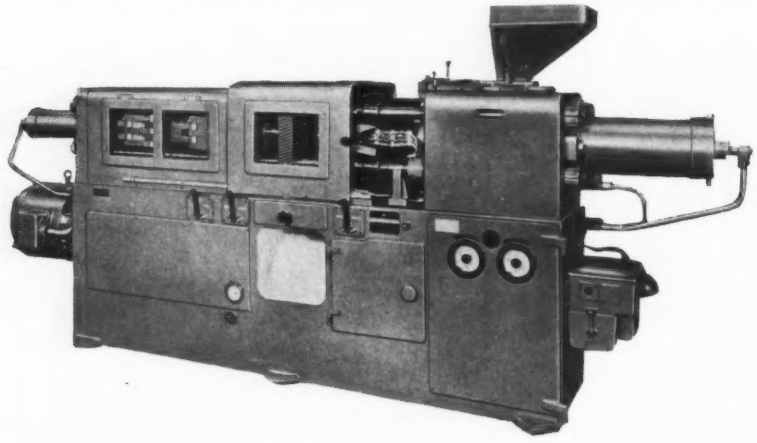
General Moulding Conditions

Provision of a mould capable of giving complete positive ejection is not in itself sufficient. In order to ensure smooth ejection, the temperature and pressure of the material in the mould must be kept constant to ensure that there is no residual cavity pressure at the time of ejection. This, in turn, means that

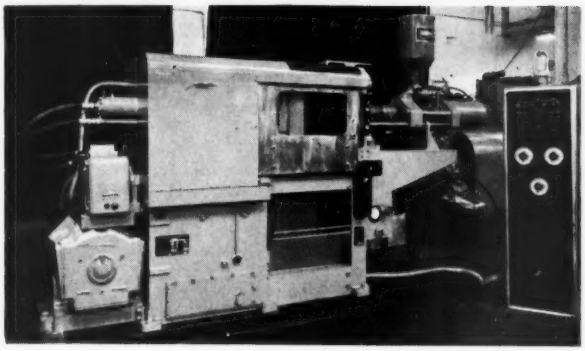
The Dowding and Doll fast cycling injection moulding machine

moulding conditions have to be kept perfectly constant, and attention has to be paid to every variable of the process. Time is controlled by automatic time switches (process timers) which eliminate the human element in regard to the mould open period, and keep constant each element of the time cycle. Precise regulation of cylinder temperature is a necessity as also is good control of mould temperature. This is facilitated by present day

* Plastics Division, Imperial Chemical Industries, Ltd.



The S.H.4 injection machine, manufactured by R. H. Windsor, Ltd.; it is provided with semi-automatic or fully automatic cycle control. The machine has a 4 oz. capacity with 250–300 shots per hour (dry run)



A view of the 20-MS-20 fully automatic injection machine, introduced recently by the Projectile & Engineering Co., Ltd.

automatic temperature control systems capable of extreme accuracy. Given these conditions, constant mould pressure behaviour is achieved by constant plunger pressure, constant feed of the thermoplastic material and, of course, consistency in the chemical nature and physical form of the material itself.

It is seen, therefore, that the requirements of successful automatic injection moulding are the very same as those necessary for consistent quality mouldings.

Safety Provisions

If a moulding fails to eject or if an inclusion is left between the faces of the mould, provision must be made to interrupt the cycle, stop the machine, and call the operator's attention. This prevents any tool damage which would otherwise occur by the mould closing and locking on a rigid inclusion.

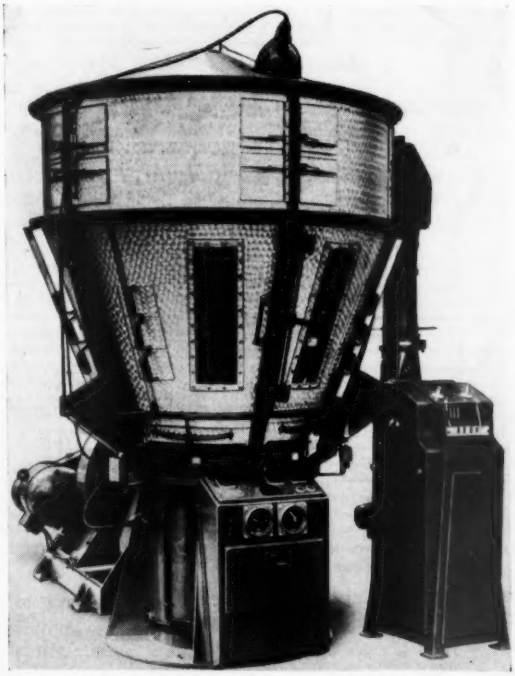
Various methods have been used to provide this facility, but one very effective design is worthy of mention. It employs a limit switch A which makes when the mould faces meet, and a second one B which makes when the locking mechanism pushes the front platen against the headstock. If A makes before B, as it will under normal conditions, automatic cycling proceeds. But, if an inclusion is left in the mould, then B makes first and this immediately opens the mould, stops the machine, and gives an alarm signal. Delicate adjustment of A is required to detect small pieces of flash whose thickness may be only a few thousandths of an inch.

As regards the future, it is only possible to speculate. Fully automatic working is unlikely to meet all moulding needs, but small high speed automatic machines may well supersede the use of multi-impression moulds on large conventional type machines for parts which lend themselves to appropriate mould design.

Automatic Glass Fibre Preforming Machine

IN the August issue of *Plastics* a description was given of the school for polyester/glass fibre technology, set up in Birmingham by B.I.P. Chemicals Ltd. One piece of equipment is worthy of special mention, since it falls within the scope of automation, the Busch glass fibre preforming machine.

The general concept of fabricating glass fibre by bonding with polyester resins may be regarded as the antithesis of automatic production, and any apparatus which assists to standardize the product and speed the rate of manufacture is bound to create considerable interest.



The Busch preforming machine

Again, as has been noted elsewhere in this review, the use of the word automation really implies process control, since the Busch machine is automatic only in so far as each cycle is concerned. Uniformity within each cycle is assured, but extraction of the preform is carried out by hand.

The Busch equipment is offered for sale in six standard sizes, with effecting diameters of preforming areas from 550 to 1900 mm. Glass, in the form of continuous rovings is fed into a cutting machine which will handle up to 2400 gm. per minute, with lengths of cut ranging from 6 to 50 mm., capable of alteration whilst the machine is running.

The cut lengths of glass monofilament are then transferred to the preforming chamber and are sucked over the preform itself.

However, the equipment incorporates several interesting features, linked with the automatic cycling. One of these is the series of baffles in the preforming chamber which divert the cut monofilaments to the required areas on the preform. A pivoted inlet for the monofilament permits the additional refinement of locating each monofilament at the required angle on the preform. Thus it is possible to place the monofilaments both in the position and in the direction desired, making the preform thicker in one place than in another.

Control is carried out from the desk seen in the illustration; by pre-setting to a desired cycle, the following parts can be controlled automatically:—(1) Direction of rotation of table. (2) Speed of rotation of table. (3) Speed of monofilament cutting. (4) Length of cut monofilament.

Preforming is of course limited to articles of a certain maximum size, but for many repetitive mouldings it is the only way to mould economically. A machine, therefore, which carries out this preforming quickly is valuable. That it also controls the amount of monofilament deposited at any one point, a procedure extremely lengthy and difficult if done by the hand lay-up technique, means that one of the biggest difficulties in the way of rapid glass/polyester moulding has been overcome.

Three Position and Stepless Controls for Extruders

By J. A. HARTNETT *

The application of instrumentation in the operation of modern extrusion equipment

WHEN we talk of instrumentation with respect to extruders, we generally have reference to temperature controls. Since temperature is a function of heating and both oil and electric heating have been used in plastics extruding, it would be well to further define our field. No attempt will be made to go into the relative merits of oil and electric heating, as this is not the subject of the article. Since the instruments that we are concerned with are primarily associated with electrical heating, we will confine this to a discussion of instruments to control electric heaters.

In the development of plastics extruders all possible means of temperature control have been tried and for various reasons, to be reviewed briefly, these experiments have lead to a single type of control that is most prevalent in the field. Some of the controls that have been used in the past have included laboratory type thermostats, variable transformers and various types of pyrometers.

Laboratory type thermostats have been used experimentally, for limited production, and were found to be inadequate for several reasons. First of all, there was no actual temperature indication so other temperature measuring devices had to be used in conjunction with them. Another reason for their inadequacy, and probably the most important, was the fact that they had a tendency to drift off their original temperature settings as they were exposed to elevated temperatures for periods of time. This resulted in frequent replacement and high maintenance costs. Apart from this, various plastic materials required different temperature settings and it was a tedious job to change thermostat settings. For these reasons thermostats have not been an important factor in the temperature control of extruders.

Another temperature control device that has become a little more widely accepted in the extruding field is the variable transformer. In theory, these controls which operate manually and adjust a percentage of line voltage input to the heater appeal to many engineers as the preferred approach to close temperature control. However, they have very serious drawbacks which become apparent in use and it would appear evident that in time they will become obsolete for this application. It is not possible with this type of a device to indicate the temperature; therefore, an additional instrument must be provided to show the actual existing condition to the operator. Since these devices operate by limiting the power to the heater, they must of necessity require extremely long warm-up time, for example, a variable transformer operating on a 230 v. line may provide the proper heat to the barrel when the transformer is set to deliver 145 v.

If one is to warm the extruder up to operating temperature with the incoming power at 145 v., you will approach your working temperature not only at a slow rate, but as you approach your working temperature, your rate becomes even slower. This is impractical, consequently most operators will manually set the transformer for full power and one will be dependent upon them to reset it before the material in the barrel or die is burned. Let us assume that this serious drawback is overcome and the barrel is up to operating temperature. This may also be a dangerous condition, since any change in load or speed of the machine will not be corrected by a change in temperature. Further, should the machine be shut down temporarily, just as much power will be put into the heaters as when drawing heat away, and the temperature must increase above the desired value resulting in burned material once more. It is a manual system requiring skill and unusual attention on the part of the operator. There is another perhaps more insidious aspect to this type of control which is often neglected, and that is the change in temperature that occurs with the change of line voltage. This, in itself, represents an input error to the heater which is the square of the change in voltage and consequently large errors may be introduced producing inferior extrusions beyond the control of the operator.

In view of the problems associated with the above methods of temperature control, pyrometers have become quite generally accepted for this application. They have the advantage of indicating the temperature at all time, they permit fast warm-up, and establish control only when the actual temperature is up to the desired value. They provide uniform control whether the machine is running or off, and they give control with respect to desired temperature rather than a function of power input. In the terminology of the highly publicized field of automation, this is known as the " Closed Loop System," and means simply that the end result desired is controlled by sensing the end result and correcting if necessary to provide a constant value. In this application, the uniform heat desired is sensed with the thermocouple and power correction is applied as needed to maintain the temperature setting on the instrument. Pyrometers are designed for industrial service and have the advantage of operating from a thermocouple temperature sensing unit which is rugged and also permits remote location of the control equipment with respect to the operating area of the machine.

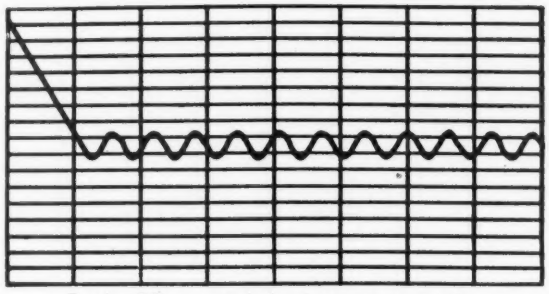


Fig. 1. Off-on control, showing constant variation.

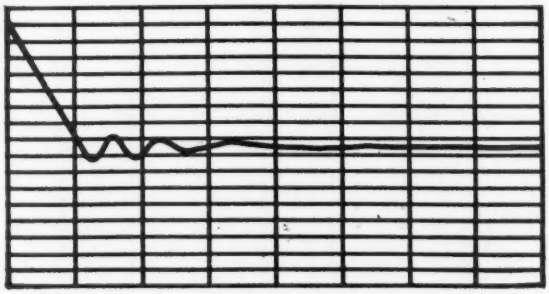


Fig. 2. Proportioning control. Compare pattern with Fig. 1 above.

* *West Instruments, Ltd.*

Rather than having reached a conclusion of our study, due to the advanced art of extruding, the need for temperature controls has progressed to exceed in many cases the basic pyrometer itself, which worked in a similar way to the laboratory thermostat, in that it would turn the heat on and off with a slight change in temperature. The very fact that a change in temperature was required to actuate the control, prevented the temperature from remaining stable. With newer materials requiring closer temperature control a better type of control appeared to be desirable.

A more advanced type of pyrometer control has generally replaced the simple on-off pyrometer referred to above, and the proportioning pyrometer controller is now generally accepted in the industry as the basic instrument for this application. In this family of controllers there are many good units manufactured. Fundamentally, they all operate on the principle of anticipating the need for a temperature change. In so doing, they tend to eliminate the temperature overshooting normally associated with simple on-off control devices and permit far more accurate control of temperatures.

As indicated above, the proportioning pyrometer controller is the work horse of the extruding field in the U.S.A., however, specific temperature control problems in extrusion are not answered alone by this instrument. Often a problem exists in the forward zones of an extruder barrel with heat of friction. This is not a new problem but it is one that is becoming increasingly important, and the past solutions to this problem have been generally a matter of manual adjustment on the part of the operator and again we find them not altogether satisfactory for up-to-date competitive practice. In this method, a blower or circulated coolant was either turned on when frictional heat was evident or often a certain amount of cooling was left on at all times resulting in a substantial waste of both coolant and electric power required to overcome this cooling.

Automatic Control

An automatic approach to this problem was therefore indicated and we adopted a standard instrument design called a three-position pyrometer controller to this need. In this instrument, there are two relays and they are so adjusted to provide essentially three control bands. A normal relay action controls the heater which provides heating up to the desired temperature at which point the relay drops out and no heat is applied to the system. Should the temperature continue to rise beyond a narrow adjustable band representing anywhere from $\frac{3}{4}\%$ to $1\frac{1}{2}\%$ of the full scale range, the instrument would then automatically operate the second relay which in turn could be used to start blowers,

APPLICATION	CONTROL FUNCTION BY INDICATING POINTER POSITION		
	Below Both Control Points	Between Control Points	Above Both Control Points
Heating with Automatic Cooling	Heat On	Heat Off	Cooling
Hi-Lo-Off	High Heat	Low Heat	Off
Hi-Med-Lo	High Heat	Medium Heat	Low Heat
Temperature Control and High Limit Control with Automatic Reset	Heat On	Heat Off	High Limit Alarm

Fig. 3. Switching possibilities with a three-position controller.

valve water or actuate whatever other automatic cooling means may be provided with the particular piece of equipment. In this way, the zones of the extruder that are subject to heat of friction are automatically controlled both under conditions of heating and cooling and this is accomplished economically since one is

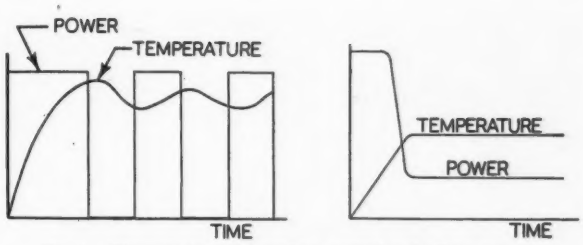


Fig. 4. Characteristics of stepless control and off-on control.

not switching directly from heating to cooling; the neutral zone, referred to above, may be adjusted to meet your own particular requirements. We have further improved upon this basic instrument by applying proportioning control to the lower band. With this version, the proportioning three-position controller, it is then possible to provide temperature control comparable to that available with a proportioning controller with the added feature of over temperature automatically controlled cooling.

There is another basic instrument need in most extruder operations and that is a matter of extremely accurate control of die temperatures. Since the die determines the dimensional tolerance of extrusions and variations in temperature can effect these tolerances as well as the surface finish it is often essential that the control is most accurate in this zone. A new type of instrument was developed and introduced at the 1952 Philadelphia Plastics Exhibition simultaneously by West Instruments and one of the extruder manufacturers. This type of controller has been in use for four years in ever increasing quantities. It has proven itself and there has been an increasing trend toward stepless controllers in the control of die temperatures.

Stepless temperature controllers, as the name suggests, apply heat or power at any level as may be required by the process. In this respect they would correspond to the theoretical objectives desired in the variable transformer with the added important advantages of operating on a " closed loop system " automatically. The heat loss in any system may be exactly matched by the heat input assuring temperature stability; further, any change in temperature due to a change in extruder speed, temporary shut-down, etc., will be compensated for by a power correction in proportion to the temperature deviation, and as the temperature returns to normal the power correction is automatically reduced to zero.

Conclusion

It is not in the intent or objective of this paper, certainly, to confuse those engaged in this field with a dissertation on a series of temperature controllers but rather to indicate the availability of specialized types to meet the exacting needs of modern operations. In general, it is considered that proportioning controllers may be applied both on the barrel and the die. Where heat of friction is a problem, it is thought that the initial zones of the barrel might very well be controlled by proportioning controllers with the final zones of the barrel controlled by the proportioning three-position controllers which will assure automatic and accurate control under normal as well as abnormal operation conditions. Further, it is considered that stepless controllers will continue to be applied in ever increasing quantities to die temperature control to assure the greatest possible accuracy in this critical zone.

As a word of caution it should be pointed out that in no way can instrument selection overcome the need for control by zones. It is essential on sheeting dies, for examples, to divide such dies into zones not exceeding approximately 10 in. in length and while stepless controllers will unquestionably provide greater accuracy, it should be remembered that in no case can the instrument do a better job than the thermocouple can sense and for this reason, it would be poor practice to increase the quality of control at the expense of quantity of controllers.

Continuous Mixing and Compounding of Plastics

A Step Towards Automation

By H. A. MARSH *

Illustrated with equipment manufactured by Werner and Pfleiderer

FULLY automatic factories, controlled by electronic computers, seem to be the ultimate aim in automation and much has already been done in many industries towards this end.

Although we are still a considerable way from this state, it can be said that individual technical developments which lend themselves to form a link in the chain of automatic operations in any manufacturing process, come within the scope of automation.

The chemical industry has already reached an advanced stage in automation where a change from the batch process to the continuous flow process has been made. The plastics industry, using raw materials in powder and liquid form and chemical and mechanical manufacturing processes, presents less difficulties of a technical nature in adopting forms of automation than some other industries.

In the processing of plastic compounds, before they are moulded, extruded or sheeted into a finished product, the mixing and compounding operation plays an important role and it is therefore essential that the design and performance of such processing machinery meet all specific requirements.

This article deals with the second of two types of equipment, the first being equipment employing a discontinuous or batch-wise process, and the second being continuous or flow-line equipment. A batch-wise compounding installation usually consists of a pre-mixer and either a mixing mill or an internal mixer.

The rapid development which has taken place in the plastics industry has brought about a tendency to change from batch-wise mixing and compounding processes to continuous ones. Continuous compounding equipment is being designed for two reasons. One is to improve the product, and the other to create a flow-line operation bringing the compounding process a step nearer full automation.

Product improvement on this equipment means that an uninterrupted flow of uniform material is available for follow-on processes which has undergone identical treatment under close control in terms of mechanical working, processing time and heat treatment. On batch units, this can rarely be achieved, for instance, where heat sensitive material is being calendered via a mixing mill and the end of the internally mixed batch having been on the hot rolls a considerably longer time than the start of the batch.

Extruders are occasionally employed as continuous mixing and compounding machines but in many cases a product of low thermal stability suffers considerably due to having to undergo two adiabatic heat cycles, the first during compounding and the second during extrusion, etc. The quality of a wide range of materials is improved if adiabatic heat input can be kept as low as possible. In fact, the aim is to create a sufficiently high gelling temperature by mechanical working and/or compression alone in order to reduce thermal stresses to a minimum.

The Continuous Gelling and Granulating Machine

This unit, known as the Werner & Pfleiderer Plastificator (Fig. 1), is a single rotor machine operating entirely without adiabatic heat input. A sufficiently high temperature for gellation is produced by friction within the material which undergoes mechanical working between rotor and rotor casing. The rotor gap, being adjustable, allows for accurate temperature control through variation in friction. The material enters the feed hopper of the machine in the form of a pre-mix and in a single continuous operation emerges as a uniformly granulated compound. The unit has a capacity of up to 250 lb. of compound per hour and is particularly suitable for the more difficult gelling of vinyl chloride suspension polymers.

The Continuous Compounding Machine

This is a large twin-rotor production unit having an output of up to 10 cwt. or 15 cwt. per hour depending on the material used (Figs. 2 and 3). The principle of operation is that of an internal mixer but on a continuous basis. The machine is of an extremely robust construction, arranged for both heating and cooling, and the rotors are supported by bearings at both ends. The material emerges in the form of an endless strip ready for continuous follow-on processes such as calendering, granulating and others.

* Jonn Kimbell and Co. Ltd.

Fig. 1a. Werner and Pfleiderer continuous gelling, compounding and granulating machine.

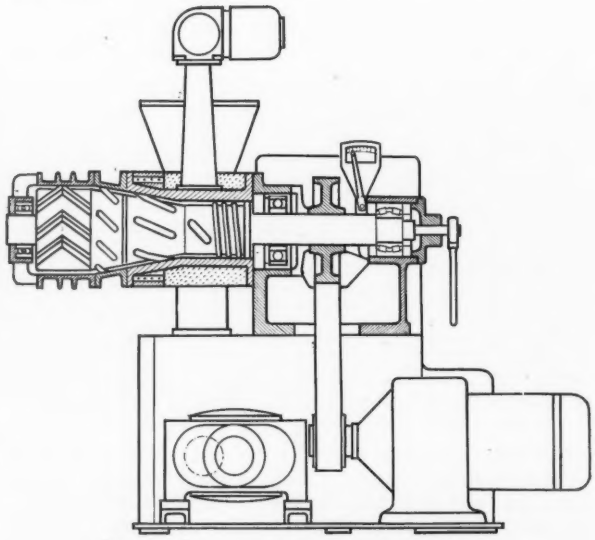


Fig. 1b. Diagrammatic cross-section of Fig 1a.

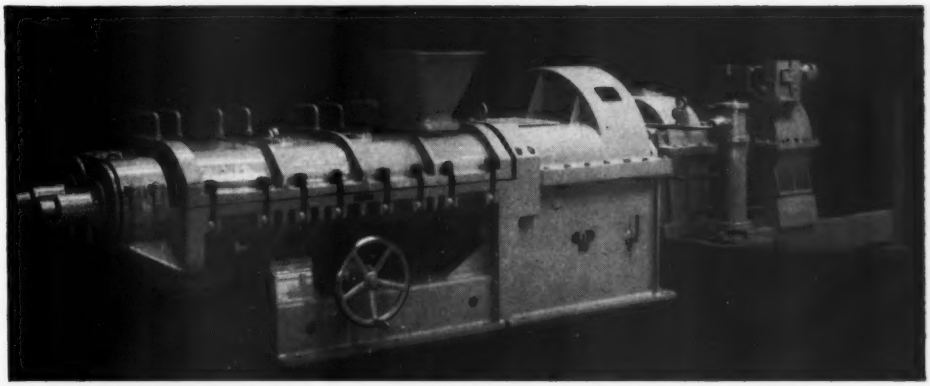
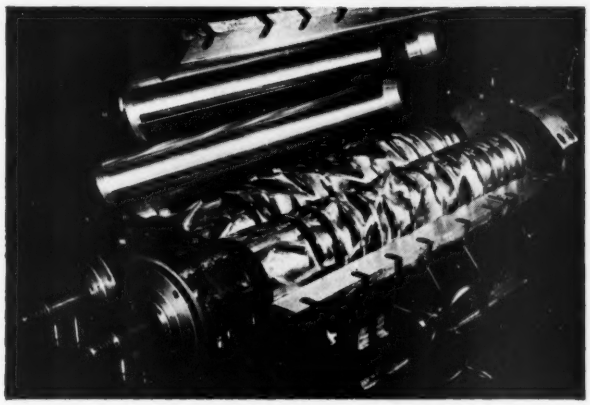


Fig. 2. Continuous compounding machine for large scale production.

Fig. 3 (Below). An open view of Fig. 2, showing the twin-rotors.



In order to make continuous compounding independent of a feed method using batch-wise pre-mixed materials, a form of mechanical dosing and metering will be necessary to bring this process still nearer automation. It has to be borne in mind, however, that the question of continuous feed control although desirable, may bring about problems causing the employment of such equipment to be ruled out entirely for reasons of economy. This lies in the diverse nature of the ingredients of a compound which, in many cases, would require a metering installation so complex and extensive that its initial cost would be quite out of proportion to that of the compounding plant.

No doubt it will be some time before the great potentialities of automation can be fully exploited in this industry and only by the closest co-operation between the user and the manufacturer of plant will it eventually become a reality.

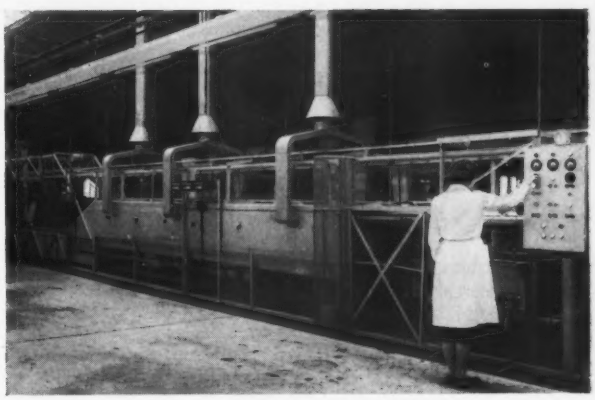
Whether a continuous or batch-wise compounding process is adopted will depend entirely on the manufacturer's individual requirements and many factors such as the type of product, its colour, formulæ and a host of others will have to be taken into consideration before the best choice can be made. Thus it will be left to the chemist and process engineer to select the best installation for the job.

Automatic Dip Moulding—Large Scale Production of P.V.C. Goods

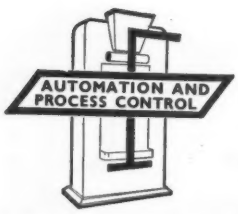
IT is not always realized that properly carried out, dip moulding can be one of the fastest methods of producing plastics articles. With cheaply made formers (by contrast with matched steel dies) and at fast cycles, very high production rates can be achieved. 200,000 units a day have been claimed, the moulding of course being of simple curvature.

As in the case of the polythene bottles, dip moulding was a natural subject for automation, and in December, 1955, we reported in detail on the plant of Creators Ltd., Sheerwater, Woking; 75 ft. long, the machine is operated by an electronic switchboard, governed by a series of process timers. The formers are suspended on racks, the racks being transported on endless belts and lifts. The sequence is as follows:—Each rack is passed into a preheating oven where the formers are heated to about 110° C.; the rack then moves into the dipping zone, and is held stationary whilst the vat of p.v.c. dispersion is raised to coat the formers; the racks then enter a curing oven and on emergence the mouldings are stripped off the formers; the racks then move up a lift onto a high level belt where they move back to start the cycle again.

Each stage of the process is automatically controlled, so that the heating of the tools, the period of tool immersion in p.v.c., and the period of curing in the oven are all carried out to set times. One operator keeps watch over the whole machine, merely in a supervisory capacity. Electronic relays will halt the sequence in any section in the event of breakdown. The incorporation of electronic equipment is not merely a means of reducing labour however; it contributes significantly towards standardization of quality, and means that the plant continuously runs at optimum conditions.



Electronically controlled p.v.c. dipping plant at Creators Ltd.



Automation without High Installation Costs

A review of the application of equipment manufactured by George Ellison Ltd., in the field of compression moulding

THE principles of automation are not new to the modern engineer. He is well aware of its need and, indeed, has been introducing it into industry in some form or another for many years.

For economic reasons, however, it is necessary to introduce automation gradually into many factories and in this respect it is interesting to consider how much time and labour can be saved with an outlay of only a few hundred pounds.

For example, many users of hydraulic power can provide themselves with a very effective form of automation by adapting existing presses with little capital outlay beyond the purchase of a few Ellison Valves and a Flex-o-timer. The types of installations envisaged are as follows:—

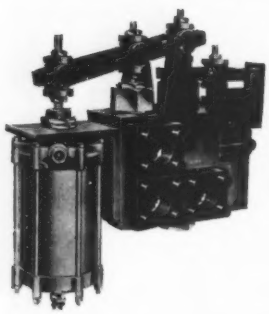
(1) Single-acting cylinder.
(2) Double-acting cylinders (constant pressure return-single acting valve).
(3) Normal two-pressure upstroking press.
(4) Downstroke prefilling press (constant pressure push-backs—three-way valve).
(5) Downstroke prefilling press (exhausted pushbacks-four-way valve).
(6) Double-acting control (either cylinder or down-stroking press).

The simplest form of automation is embodied in the Ellison three-way single handle valve for use with two pressures. It provides a simple means of single handle control to prevent the misuse of high pressure fluid. The low pressure and exhaust units are geared together for operation by the single handle and a high pressure/low pressure changeover unit is also incorporated. The opening of the high pressure side of the changeover unit is initiated by build up of pressure from the low pressure system and completed by the admission of high pressure fluid.

Control of the pressure at which high pressure fluid is admitted is effected by adjustment of a spring on the change-over unit.

By introducing air as the operating pressure at up to 20 p.s.i., Ellison valves can be supplied for remote control in conjunction with a Flex-o-timer. This means that for an outlay of about £200 to £700, depending on the hydraulic circuit, two or more hydraulic presses can be automatically controlled by a single operator. In the cases of rubber and plastics moulding, the number of presses that can be controlled in this manner will be dependent upon the time cycle of cure.

The timer requires very little space and is fitted with small air valves that are air operated by cams on a rotating drum, adjusted to give the sequence required. Up to 20 functions can be achieved off a single timer, and breathing, for plastics and rubber moulding, is permissible up to six times.



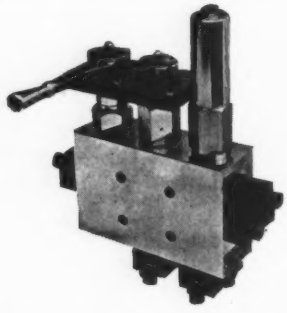


Fig. 1 (Left). Three-way valve for operation by double-acting air cylinders.
Fig. 2 (Right). Three-way valve with high pressure unit automatically controlled by a changeover unit.

Fig. 3. Timer control on a 20-ton upstroking press.

Fig. 3 shows a timer control on the simplest of circuits; that of a 20-ton upstroking press working on one pressure again on plastic moulding.

Here the sequence is simply to control the two-way valve and its function is that the closing of the press guard which is done by the air valves shown in the picture releases a mechanical device which permits the control valve to be operated and at the same time covers the push button which energises the timer. The moulds are then closed and pressure is applied. Breathing takes place (pressure being applied and exhausted) and then pressure is maintained for the cure period. At the end of this time the table falls due to the control valve being opened to exhaust and the operator can now open the press guard to remove the moulding.

One important advantage of this form of automation is its simple adaption to safety devices as, for example, the automatic control of press guards to comply with factory inspectors' requirements. It is an easy job also to incorporate such safety features as an emergency push button on the timer which, when

operated, would cause the hydraulic pressure to fall to safety. Further, the failure of air pressure would cause the hydraulic pressure to exhaust.

The press and valves shown in Figs. 4 and 5 are used for plastic moulding. It is a down stroking press fitted with a prefilling tank and push back rams. In addition to a one ton per square inch pressure line there is a 2 to 1 intensifier which gives a final pressure squeeze of 2 tons per square inch.

Control Valves

The Ellison control valves for the operation of this circuit consists of:—For the main ram a four-way valve having two pressure and two exhaust controls. The two exhaust valves are coupled together for operation by one air diaphragm and the two pressure controls are each operated by their own diaphragm. For the intensifier—one two-way valve having a pressure and exhaust control coupled together by levers for operation by one diaphragm.

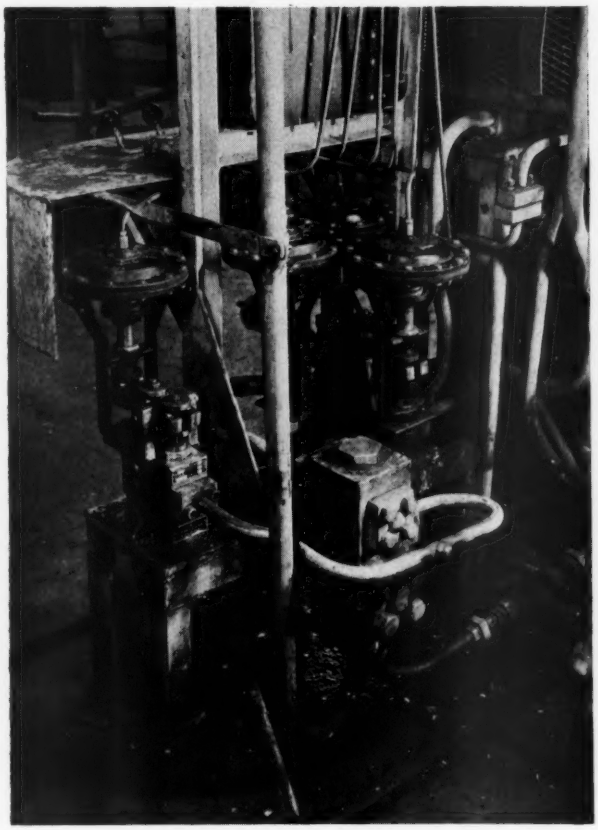


Fig. 4. Control valves for press shown in Fig. 5.

Function

The function of the valves with the timer is initiated by the closing of the press guard. This sets the timer in motion and the following functions take place. (1) After loading the mould the operator closes the press guard which sets the timer in motion. (2) Timer by means of the cam operated air valves, closes the push back pressure valve and the main cylinder exhaust valve which, through the levers, opens the push back exhaust. This permits the main ram to fall, the cylinder prefilling at the same time. (3) When the moulds close, the main cylinder pressure valve is opened and a pressure of one ton per square inch is applied. (4) After a short period of this pressure, the pressure is exhausted and applied again on three occasions in order to " breath " the moulding. (5) When this has taken place a pressure of one ton per square inch is built up and then the intensified pressure of two tons per square inch is applied for the required cure time by the operating of the two-way valve. (6) At the end of the cure time the intensifier control is exhausted, the main cylinder pressure control is closed, the main cylinder exhaust is opened and in so closing the push back pressure closes and the push back pressure opens. (7) Operator now lifts the press guard and is ready to remove moulding and recharge for the next moulding.

It will be seen from the foregoing sequence that the control is fairly intricate but it was possible to achieve all that was required with the single timer. This plant was installed in October 1950 and since then the four-way valve has been developed so that only two diaphragms are required to control the four-way valve instead of three as described.

Fig. 5. Down stroking press fitted with prefilling tank and push back rams.

The pneumatic hand controls shown in Fig. 4 are used for the purpose of tool setting.

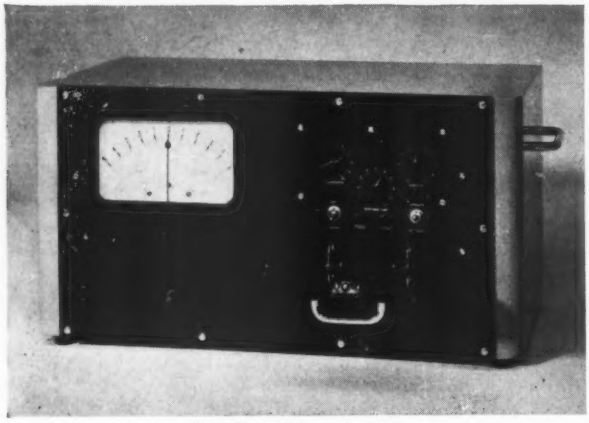
For those who are unfamiliar with the Ellison valve, it should be said that it marks a significant step forward in hydraulic practice, embodying new features to prevent scoring of seats and stems and to ensure trouble-free service with little maintenance. The standard range covers valves for single and multi-pressure systems of up to 4,480 p.s.i., although for some duties they are supplied for pressures of up to about 6,720 p.s.i. inch and single-way valves are available for pressures of up to 10,000 p.s.i. The standard port sizes are $\frac{3}{8}$ in., $\frac{5}{8}$ in., $\frac{7}{8}$ in. and $1\frac{1}{8}$ in., but the makers are interested in extending the range to cover other sizes. The pressure fluid may be water or oil.

Air operation is achieved with an air cylinder operating at pressures of 15 to 100 p.s.i., or air diaphragm operating at pressures of from 15 to 40 p.s.i., to suit individual requirements. With the hand-operated valves, arrangements have been incorporated in the design to ensure that operation is achieved by an easy, small angular movement of the short handle, thereby reducing operators' fatigue on overtime working to a minimum.

Industrial Nucleonic Equiqment

Three pieces of apparatus now in use by the Plastics Industry briefly reviewed by the staff of Isotope Developments Ltd.

INDUSTRIAL applications of nucleonics and radioactive isotopes are finding very wide use in providing closer control of processes, the speeding of production and a reduction in waste. Some of these applications are of particular interest to manufacturers in the plastics industry.



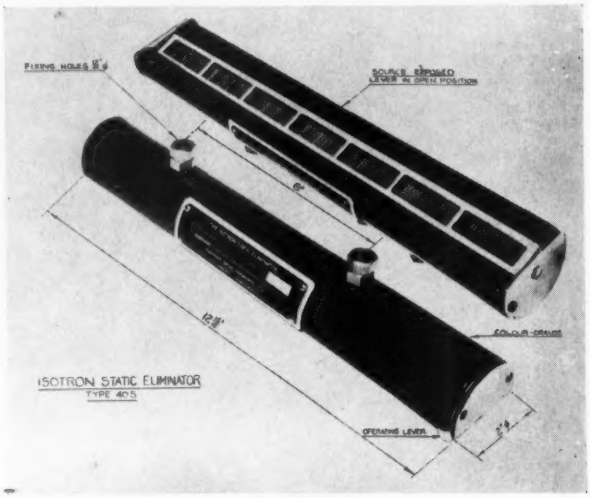
Beta Ray thickness gauge.

An instrument which is already assuming a position of standard instrumentation for use during the manufacture of plastic sheet, is the Beta Ray thickness gauge. This is based on the transmission of a radioactive beam through the material by which it is possible to very accurately gauge the weight, thickness or density of the sheet. A particular advantage of this method of measurement is that it is non-contact, and therefore, in no way deforms the product however delicate, and it may be used either at low or high speeds with a very great degree of accuracy.

Investigation is proceeding to apply this principle, to the measurement of curved surfaces, i.e. extruded tube, etc., and as a reflection type instrument. In the latter case there are certain advantages in measuring rubber and plastics on the callender bowl but it must be emphasized that there is a reduction of accuracy of measurement. It is therefore preferable, where possible, to employ the transmission thickness gauge.

The elimination of static electricity is also of interest to the plastics industry, particularly where plastic pastes incorporating organic solvents are involved. For this purpose there is available a static eliminator incorporating radioactive isotopes.

This type of eliminator, which is carefully designed for optimum effect, has the advantage that it is small and is therefore capable of being fitted into a confined space, lasts virtually



Static Eliminator.

indefinitely, and requires no power to operate it. Being based on the use of isotopes, it produces no spark discharge. It will therefore, be eminently suitable for processes such as the spreading of plastic pastes on to sheet materials, or in the preparation or converting of inflammable natural or synthetic sheet materials.

An indirect application for laboratory nucleonic instruments in the plastics industry is in connection with the increasing interest in isotopes for the irradiation of materials. This broadly consists of using large energy fluxes produced from radioactive isotopes, and exposing materials to them for the purpose of altering the structure of other characteristics of plastic materials.

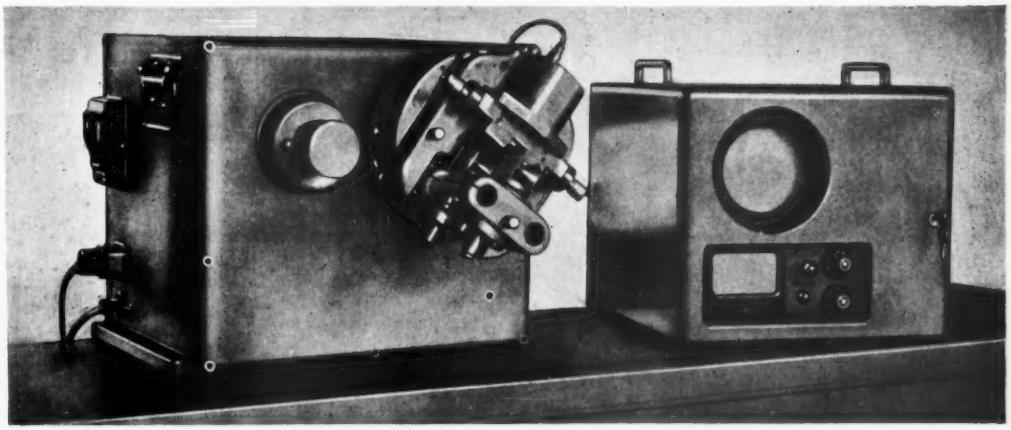
Interest is also being shown in the use of large fluxes as produced from radioactive isotopes, for the purpose of speeding chemical processes in the cold. It can be likened to the use of catalysts in certain chemical processes.

Push Button Process Timing

IN this age of automation every move towards precision process timing, so as to overcome the possibility of human error, is a step in the right direction. Venner Ltd., with the redesign of their synchronous motor driven process timer which now incorporates a push button for repeating a set timing period mechanically, have made a significant contribution to automation.

The PT4 process timer, which supersedes the non-repeating type PT3, repeats the set timing period each time the push button is pressed. To set the timer, the pointer is turned to the required period and locked by means of a knurled locking ring. On pressing the centre button, the contacts change over and the set timing period commences. At the end of this time the contacts change back and the timer accurately resets, ready to repeat the period when the push button is again pressed.

50-ton press, with Venner timer, at the moulding works of Prestware Ltd., Raynes Park.



The Eccentricity Tester 80–3, manufactured by E. Fischer & Co. of Switzerland and marketed by Warbrick (Engineering Specialties) Ltd.

Electronic Eccentricity Gauge

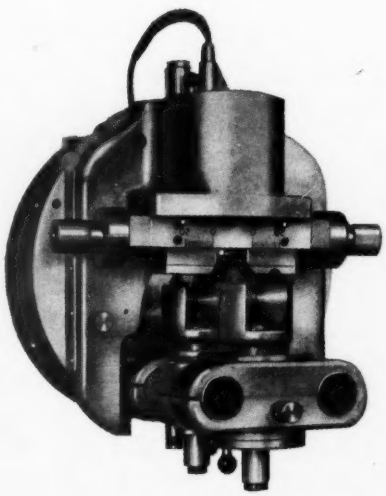
THE purpose of this eccentricity gauge is to ascertain the position of the core or conductor relative to the insulating sheath. The equipment does this continuously without hindering or interfering with the extrusion process and without cutting or other physical examination of the cable. Apart from cable or other covering jobs the testing equipment can be used to check the bore of tubing where close tolerances are required.

The equipment consists basically of a measuring head and an oscillograph. The cable or tube is fed through the head after preliminary cooling where it is supported by grooved rollers. These rollers can be adjusted in two planes (horizontal and vertical) by means of micrometer screws to accommodate different diameter cables. The correct setting, which allows the cable free passage without permitting it to wander from beneath the probe can be noted from the scale marked on the adjusting screws. The cable then passes either to a further cooling trough or to the measuring or take-off equipment. When running, the measuring head revolves round the extrusion and transmits the picture to the oscillograph. Here the picture is projected on to the front of a cathode ray tube where it can be compared with a scale of concentric circles the centre of which is the centre of the tube. Thus if the conductor of a cable is at the centre of the extruded insulation the centre of the transmitted picture, which is a green circle, will coincide with the centre of the screen. Any deflection from this position of the conductor will show in a corresponding movement of the picture from the centre of the screen. Not only does this show that there is eccentricity but also its direction is indicated. To compensate for any twisting or drag in the cable before it reaches the gauge a control is incorporated in the measuring instrument which will enable a correct picture of the cable at the extruder die to be obtained. Various other controls on the oscillograph are shown in the diagram and a door can shut off those which do not need altering after the initial setting. The oscillograph can be used with three measuring heads, a three position switch connecting up the different circuits as required, also a plug is fitted which can be used as a connection for various accessories such as a recorder, visual or sound signalling device when tolerances are exceeded, or a servo mechanism. As a check on correct working there is a meter which registers under normal conditions but on a circuit failure will not give any reading. Valves and circuits can be checked for failure by a multi-position switch which localises each of them.

The eccentricity tester will accept and check cables or tubes from 0·012 in. up to 3·15 in. diameter and can be used with all of the insulating materials. On laid up multicore cables the picture represents the average diameter, treating the multiple wires as a solid core. With the addition of a special device on the measuring head coaxial and screened cables can be gauged.

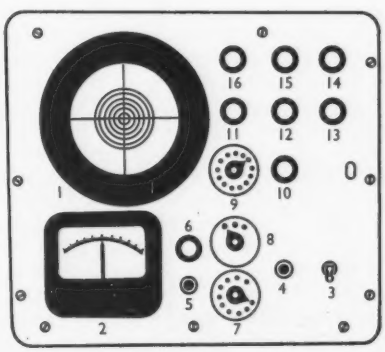
Among the advantages claimed in the use of these eccentricity gauges besides the obvious one of uniform quality is the increased running speed made possible, a saving in raw material and a reduction in rejected extrusions.

The instrument is manufactured by E. Fischer & Co., of Switzerland, and marketed by Warbrick (Engineering Specialties) Ltd., Sankey Street, Warrington, Lancs.

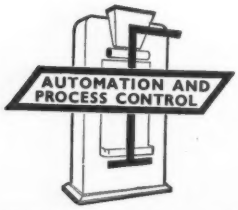


(Left) The measuring head showing the grooved guide rollers and micrometer screws.

(Right) A drawing of the complete control panel on the oscillograph.



1. Screen (on which a green circle indicates conductor).
2. Central Zero meter for checking Oscillograph tube and valves and adjustment of discriminator (10).
3. On/off switch.
4. Fuse.
5. Adjustment check button.
6. Screen light button.
7. 10-position sensitivity switch.
8. Selector switch for up to three heads (Tester 80–3).
9. Switch for meter (2) with 12 stations.
10. Discriminator.
11. Focus adjustment.
12. Astigmat.
13. Horizontal adjustment.
14. Vertical adjustment.
15. Adjustment for size of green circle.
16. Adjustment for brightness of green circle.



Dynamatic Couplings for Plastics Machinery

The use of electronics in the automatic control of drive in extrusion and other equipment*

THE Heenan dynamatic coupling is a variable speed device which is electronically controlled and has applications in almost every type of industry.

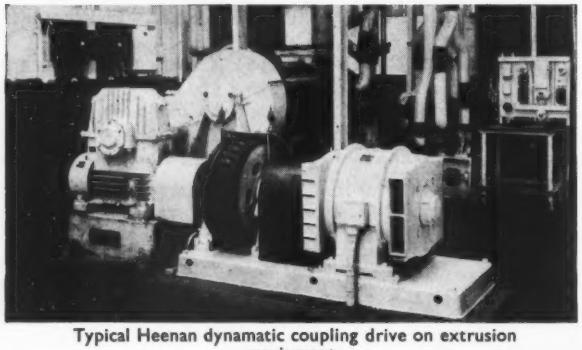
It consists of two concentric but independent members, the outer one being driven by a motor or other means and the other connected to the driven mechanism. The inner member supports the circumferentially wound coil which is connected to the excitation unit through the sliprings.

When no current is passing through the coil there is no drive, even with the motor running at full speed. As soon as the coil is excited, however, an electro-magnetic drag is created tending to rotate the driven member. The amount of drag, and hence the speed of the driven member, is varied by controlling the amount of exciting current. In many cases this is controlled automatically through the excitation unit. The coupling is not a torque converter; the output torque always equals the nett input torque.

In the production of plastics the very nature of the product calls for many different processes between raw material and the finished product. In many cases the machines have to be co-ordinated to allow for changes in the nature of the material during the various stages of manufacture.

In the extrusion of plastics, where the material has to pass through a number of other processes before being coiled or batched it is possible to adjust manually the speeds of the various machines. However, it is desirable that such adjustment should take place automatically to keep—for example—the required tension in the material.

This applies particularly when the finished product is reeled and it is essential that the tension remains constant under close limits during build-up on the reel.



Typical Heenan dynamatic coupling drive on extrusion equipment.

The Heenan dynamatic coupling with its infinitely variable speed and cushioned drive with the advantage of controlling the torque and/or acceleration or deceleration makes it ideally suitable for this class of work. As the control of the coupling is carried out electronically it is possible to make use of changes in pressure, temperature, etc., to vary automatically the coupling output to correct any variation in the process. The many characteristics necessary to suit special operating conditions can be achieved by relatively simple alterations to the basic electronic circuit. For example 100% synchronization between a number of independent drives can be arranged easily with the addition of small transmitters and receivers and a very simple extra circuit.

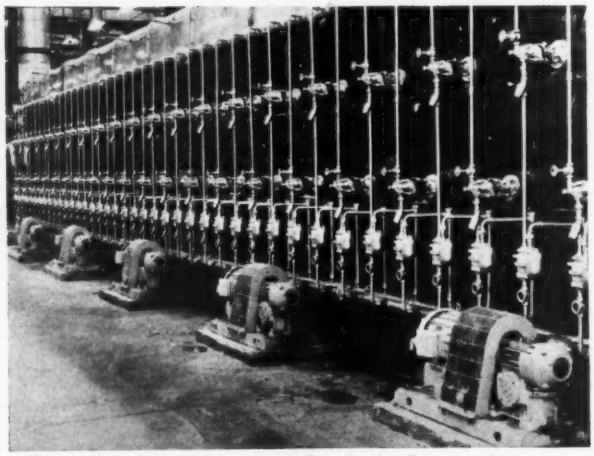
The electronic control gear is fed from A.C. mains and converts this current into the necessary D.C. excitation for the coupling. In this respect it is important to note that the excitation power requirements are very small compared to the actual power transmitted by the coupling.

In the manufacture of plastic-covered cable it is essential that the speed of the extruder screw and the speed of the capstan be variable over an appreciable range with facilities to vary the speed of one independently of the other; moreover, when the two relative speeds are set, to vary the speed of both screw and capstan together in synchronism. If cable of uniform size is to be produced it is essential that the selected speed of both screw and capstan remain stable, otherwise the thickness of insulation will vary in accordance with speed fluctuation. Consequently, a high degree of speed-holding is most important for both drives. It follows that if the speed of the extruder and capstan are variable then the take-up frame will have to accommodate, not only a change in reel speed due to build-up conditions, but also a change in the linear speed of the cable.

An extruder can be driven by a squirrel cage A.C. motor through a Heenan dynamatic coupling to give a wide speed range of the extruder screw. The speed of the extruder is capable of being controlled individually or together in synchronism with the capstan, which is driven by another coupling having a similar driving motor. The control gear provides controlled acceleration and deceleration of extruder and capstan which ensures a high degree of synchronization under these conditions and also over the complete speed range. Other features which can be included are tachometers for measuring extruder screw speed and cable speed and an overload protection device arranged to switch off the extruder motor and coupling simultaneously with capstan motor and coupling in the event of either drive becoming overloaded.

The drive for the cable take-up unit consists of another coupling with squirrel cage motor, with control gear that allows the coupling output speed to follow the speed of the cable set by the capstan and also causes the speed of the reels to decrease in accordance with the build-up.

If high quality cable is to be manufactured quickly and efficiently with plant of this type that requires synchronization and co-ordinated action of related machines, then the choice of drive to each machine becomes vitally important. Ultimately, the performance of the plant will depend upon the flexibility and performance of the variable speed drives.



Some of the drives in use on a plant at the Coventry factory of Courtaulds Ltd.

* Heenan and Froude Ltd., Worcester.

Automation Equipment

A review of the latest equipment for Temperature Control, Process Control, Laboratory, Testing and other equipment.

P.V.A. plant control panel at British Oxygen Company.

THE success of any automatic system is allied irrevocably to the efficiency of its instruments. No system could ever function successfully or be economic if the controlling instruments were not as good as and in many cases better than the human element. With the development and improvement of these controls so automation becomes more practicable and its adoption more general.

For the plastics industry, and indeed for many other industries, it is not sufficient or economic for an instrument to operate only under certain conditions. Different processes carried out on the same machine may necessitate an entirely different set of controlling influences and even a slight variation in atmospheric conditions may make necessary an alteration to a cycle of operations. It is obvious, therefore, that instruments must be flexible in their ability to control and with such flexibility must go an ease of setting. In all the cases which have been mentioned in this review it will be seen that the changing of an operating cycle can be effected within a very wide range by the simple adjustment of the existing controls.

TEMPERATURE CONTROLS

The Cambridge Thermometer Regulator.—This self contained unit has been designed for use with electrically heated processes and is available for different temperature ranges. It consists of a 4-in. dial thermometer provided with an adjustable contact by means of which a self-contained tilting mercury switch controls the electric heating supply. The thermometer contacts only carry a small current but the switch operated by them will carry up to 20 amps. A.C. or D.C. at any voltage up to 250. A slight adjustment will increase this figure so that the switch will break circuits up to 440 volts. A small neon lamp indicates when the heater is on. A similar regulator with contacts operating a small solenoid valve for controlling the temperature where gas heating is used is available.

Cambridge Instrument Co., Ltd., 13 *Grosvenor Place, London, S.W.*1.

Ether Thermatrol Controller.—The temperature sensitive element in this controller is a platinum wire resistance or Thermobulb. The resistance in this element changes in proportion to its temperature causing an unbalanced condition in an A.C. bridge circuit. A relay opens or closes an electrical circuit depending on the phase angle of the input voltage to the amplifier. The system can be used with suitable contactors, motor or solenoid valves to control electrical, gas, steam or oil fired heating apparatus. The circuit is designed so that all variations due to temperature changes of instrument and leads are eliminated and also no cold junction is required.

Ether Wheelco Capacitrol Controllers.—The capacitrol controller is an electronic controller actuated by a thermocouple or resistance bulb. An oscillator circuit maintains or breaks the relay contacts according to the position of a flag mounted on the temperature indicating arm. The motion of this flag within the coils varies their inductance causing a variation in the oscillatory energy of the circuit to the tube. The output of the tube operates a relay coil and moving armature to actuate the contacts to complete the circuit.

Ether Transitrol Temperature Controller.—This is a new direct deflection instrument for indicating and controlling temperature to close accuracy over a wide range. The controller operates on a new principle which utilizes a transistor and, in consequence, the need for thermionic valves, magnetic amplifiers, and oscillator circuits has been eliminated. The Transitrol incorporates a conventional galvanometer used as the measuring system, and an indicating pointer. The latter operates a simple photo-electric system which controls the heating medium.

Ether Ltd., Tyburn Road, Erdington, Birmingham, 24.

Fielden Pyro-Servograph.—Various types of temperature charting and controlling instruments come within this range. Their operation being on the variable condenser principle where the output from the thermocouple is fed to a moving-coil millivolt meter whose pointer has been replaced by a metal vane which acts as one plate of the condenser. A similar vane moves in the same arc as the meter vane the spacing being maintained by an electronic capacity relay which controls the servo motor and the pen unit.

Fielden Electronics Ltd., Wythenshawe, Manchester.

Beanwy Induction Heater Controllers.—These controllers and thermostats have been designed for use with the Beanwy induction heated platens. On small platens a surface mounted thermostat is used and on larger ones a stem type temperature selector. A suitable control unit is also available.

Complete control panels including switchgear and all temperature and time controllers can be made up as required.

Beanwy Electric Ltd., Rushey Lane, Tyseley, Birmingham, 11.

(Left) Temperature control panel and desk for the Telegraph Construction & Maintenance Co., Ltd., paper coating plant.

(Right) Ether Transitrol temperature controller.

Airmec temperature control unit.

Airmec Temperature Control Unit.—The temperature range for which these units will operate is from —46° C. to 300° C. when employing the resistance element which is normally a flat winding on mica with mica insulation. This element forms one arm of a bridge circuit, the other arm being variable. The bridge out-of-balance voltage is amplified to operate two separate relays via a phase sensitive detector. Either relay can be used to operate the heating system providing the rating of the relay (5 amp. at 230 volts) is not exceeded. For immersion in liquids, or use in corrosive atmospheres or high humidity, a sealed platinum bulb thermometer may be used as the temperature sensitive element in place of the winding.

Airmec Ltd., High Wycombe, Bucks.

Foster Indicating Controller.—The method of control in this instrument is by the Resilia moving coil system forming part of an oscillatory circuit connected to a trigger circuit controlling a relay which is connected to a final relay providing the control for the energy input to the plant. The control is virtually instantaneous and has a stability of $\pm 0.1\%$ with variation of $\pm 10\%$ of input voltage.

Foster Instrument Co., Ltd., Letchworth, Herts.

PROCESS CONTROL EQUIPMENT

Beta Ray Thickness Gauge.—This gauge equipment which can be obtained in Britain is of German origin and consists of the radiation source and ionization chamber control unit with deviation indicator and nominal valve setting gauge, and amplifier unit. The amplifier unit also holds the recording unit which maintains a record of variations.

International Corporation Ltd., 1 Cornwall Road, London, S.E.1.

Baldwin Radiation Thickness Gauge.—Beta radiation from a radio active source suitably screened to direct the radiation at a passing sheet is either reflected, absorbed or passes through. Depending on the weight per unit area or the thickness of the sheet so the fraction of incident radiation is transmitted to the detector. After appropriate amplification this serves to indicate the thickness or weight. If the thickness is known, density can be checked by this method. Several different models are available either with the source and detector on different sides of the sheet or with them on the same side. The latter is known as the Back-scatter gauge, and it is used over cylinders providing the mean atomic number of the coating or material is appreciably different to the base or background. The sensitivity of the instrument is usually better than $\pm 1\%$ of actual weight per unit area.

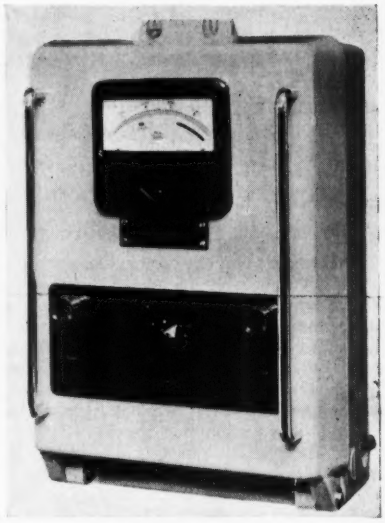
Nucleonic Level Indicator.—This new level indicator makes use of gamma radiation. A gamma emitting isotope is placed on one side of a container and a detector on the other. Radiation passes from the isotope, through the container to the detector which is in fact a geiger counter. The output from the detector is proportional to the amount of radiation which it receives. The difference in radiation reaching the detector caused by the contents of the container obstructing the beam, is shown as a difference in electrical output from the geiger counter, and this is arranged to operate a relay.

For complete control, two heads can be fitted to the container thereby giving indication when the contents reach both maximum and minimum levels. Alternatively, a moveable head can be fitted so that the " level " can be determined at any given time.

Baldwin-Dunlop Statigun.—The principle by which this instrument operates is that a small voltage, proportional to that being measured, is induced by capacitive coupling onto the grid of an electrometer valve. The anode current of the valve is measured by an indicating instrument, calibrated to read in terms of the inducing voltage by the distance separating its source from the instrument. The measurement is thus of voltage gradient or volts per foot.

Baldwin Instrument Co., Ltd., Dartford, Kent.

Evershed Electronic Controllers.—The Evershed process control system, now in use in several of the latest refineries, operates electronically. The quantity to be controlled is translated into an electrical signal in a transmitter. This signal is compared with an electrical signal corresponding to the desired value, and results in a final signal which represents the error in the system. This final signal is used to provide proportional control of a regulating unit and can, if required, be used to provide 2 and 3 term control by electrical integrating and differentiating methods. In most cases the regulating unit is the standard type of diaphragm operated control valve.



Baldwin nucleonic level indicator.

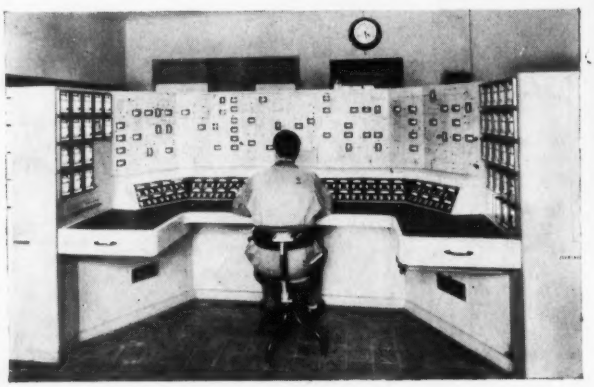
The method of converting the quantity to be controlled into an electrical signal is that known as the Evershed Electronic Repeater system. In every case the electrical signal is exactly the same and takes the form of a small D.C. current which varies from 0–30 milli-amperes for the full range being measured.

The electronic repeater system is a torque balance system in which a small torque due to a measuring element is balanced by the torque due to the reaction of a permanent magnet and a current derived from an electronic tube. The two forces are continuously compared and an unbalance operates biasing contacts connected to the grid of the tube in order to restore the balanced state.

The regulating unit is usually a diaphragm operated control valve and the conversion of the electrical signal into valve position using pneumatic pressure as the motive power is performed by an electro-pneumatic relay.

Evershed & Vignoles Ltd., Chiswick, London, W.4.

Airmec Photocell Units.—These consist of a light source, usually a 6-volt 3-watt lamp operating from an A.C. or D.C. current supply



Evershed control desk for operating a catalytic polymerization process.

Refrigerator door trims moulded in Lustrex by G.E.C.

Lustrex is a Registered Trade Mark

MONSANTO
Regd.

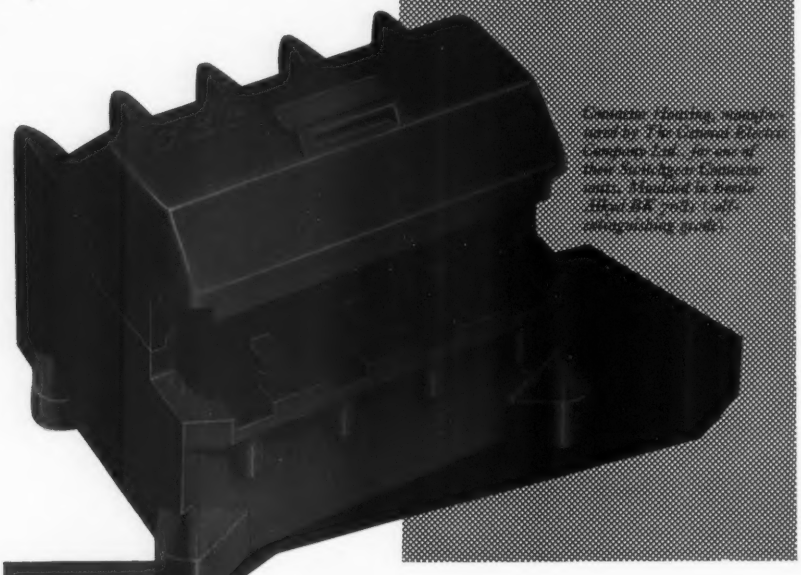
MONSANTO PLASTICS LIMITED,

92 Monsanto House, Victoria Street, London, S.W.1
and at Royal Exchange, Manchester, 2.

In association with : Monsanto Chemical Company, St. Louis, U.S.A. Monsanto Canada Limited, Montreal. Monsanto Chemicals (Australia) Ltd., Melbourne. Monsanto Chemicals of India Private Ltd., Bombay. Representatives in the world's principal cities.

K

for excellent dielectric properties . . .



high productivity

economy in tool costs

The rapid-cure properties of Beetle Alkyd Moulding Powders mean higher rates of production from existing tools. When ordering new tools, moulders therefore find that they can effect economies in cost and speed up deliveries of tools by reducing the number of impressions.

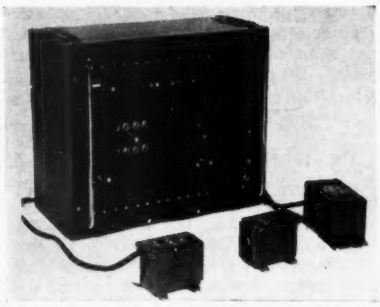
Mouldings made from Beetle Alkyd Moulding Powders, the latest addition to the Beetle range, are noteworthy for their electrical characteristics, especially arc resistance, low power factor and anti-tracking properties. They have good heat resisting properties, dimensional stability, chemical resistance and low water absorption. *Beetle Alkyd Moulding Powders pellet easily and can be moulded in ordinary compression and transfer presses; curing times are 25-30% less than for most u/f and phenolic moulding powders.*

rapid cure

BEETLE ALKYD

moulding powders B·I·P

B.I.P. CHEMICALS LTD. Oldbury, Birmingham. *Telephone:* Broadwell 2061
LONDON OFFICE: 1 Argyll Street, London, W.1. *Telephone:* Gerrard 7971



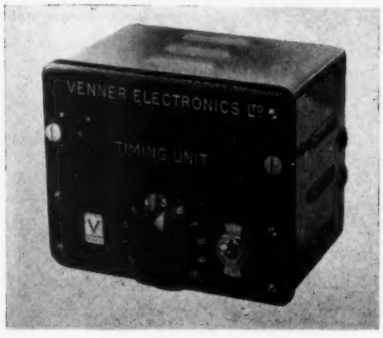
The Airmec electronic counter and photo-electric cell.

although the latter is preferred, and the photo-cell unit containing a photoelectric cell and buffer valve. The latter can be operated as a cathode-follower, as an amplifier, or as a switching valve.

Airmec Electronic Counter.—The electronic counter is used in conjunction with the photo-cell unit described above. Besides performing counting and batching operations it can be used for measuring the length of material passing a given point or for totalling the length of a large number of short pieces of material. Certain easily fitted adapting devices (such as additional cell units) are necessary in some cases.
Airmec Ltd., High Wycombe, Bucks.

Servis Recording Instruments.—These instruments have been designed to work independently of the machine to which they are attached and they provide a record of the working time of the machine. From the charts it can be seen if a correct moulding cycle is being maintained and also if there is any unnecessary machine idle time. The charts and recorders are available for various periods up to 72 hours. A simple punching attachment enables the operator to mark the chart to indicate the cause of a delay.
Servis Recorders Ltd., 19 London Road, Gloucester.

Electronic Process Timing Unit.—Almost any time sequence involving individual times of five minutes or less can be met using the Venner Electronic Process Timer without making any wiring alterations to the instrument itself. This is accomplished by arranging that a momentary contact (made for example, by a push button), will start the timing period, changing over the single pole contacts. At the end of this period the contacts change back and an output lead is momentarily short circuited. This lead can be connected to the input of the next timer and this will therefore start the second timing period. This process can be repeated as many times as required and if necessary the pulse from the last unit may be passed back to the first so that the chain will form a cyclic timer. The time delays may run from fractions of a second to five minutes.
Venner Electronics Ltd., Kingston By-Pass, New Malden, Surrey.



(Left) The Venner electronic timing unit.

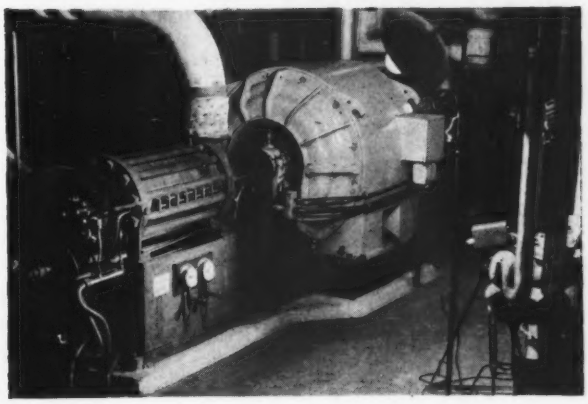
Londex Photo-electric Extension Equipment.—The extension equipment has the advantage that the light source and receiver can be mounted up to 10 ft. away from the control unit. The unit is capable of projecting a beam of small cross section with a range of up to 6 ft. More powerful units with ranges up to 65 ft. are available but not in the extension equipment. The receiver units incorporate a photo-cell, cold cathode valve, voltage stabilizer, relay and sensitivity control. Additional fittings can include a time delay device of ½ second where the unit is used for oil flame failure detection to overcome the possibility of false operation due to smoke or flame flutter.

Londex Synchronous Process Timers.—The timer consists essentially of a continuously running synchronous motor coupled during timing periods to an electro magnetically operated friction clutch. The clutch can be arranged for operation by a continuous contact, or by a momentary impulse, when it is held in over an internal locking circuit until the end of the preset time.

Londex Midget Relay.—Standard contacts for this relay can be arranged as follows: Single, double or triple pole, normally open, normally closed or double throw. The armature is spring controlled which allows the relay to operate in any position and the coil can be supplied for voltages up to 450 v. A.C. or 165 v. D.C.
Londex Ltd., Anerley Road, London, S.E.20.

Sunvic Nullmatic Controllers.—The controllers operate on the pneumatic force-balance system which eliminates the use of friction producing members. These controllers can be used to control, flow, liquid-level, and specific gravity. For temperature measurement the system can be used in conjunction with a gas filled thermal system in which variations in the gas pressure actuate a pneumatic transmitter which in turn provides the movement of the stylus on the recording instrument.
Sunvic Controls Ltd., Templefields, Harlow, Essex.

Marconi Industrial Television Equipment.—A new and valuable piece of control equipment is the closed circuit industrial television. The camera is extremely compact and the control unit simple to operate. It enables the remote observation of processes machinery and gauges where it would be impossible or dangerous for on the spot control to be effected.
Marconi Wireless Telegraph Co., Ltd., Chelmsford, Essex.



(Right) A small Marconi television camera mounted (right) for observation of a feed pump.

Londex photo-electric extension equipment.

Ediswan Servo Unit.—This is a self-contained unit to operate a servo motor and provides all power supplies, amplifier, facilities for velocity feed-back, and both positive and negative reference voltages. In conjunction with the Evershed & Vignoles' servo motor, the unit will provide a complete servo system.

Ediswan Electronic Process Controller.—This is a new device which can be used for automatically controlling up to six functions. It operates by dividing the total time of the process into 24 or less units of time of which some are basic times for the shortest functions. The others can be increased up to one minute by the correction of time delay devices. This arrangement is achieved by having an eight bank 24 position Uniselector switch normally impulsed by the basic short period timer which can be set from approximately ¼ second to 5 seconds. At any position, however, one of four other electronic timing devices can be connected in so as to give a dwell on that position up to 60 seconds. The same timing device may be connected so as to repeat its delaying effect in as many positions as desired, so that the extreme limitations of the process to be controlled are from 24 × ¼ seconds or 6 seconds, to 24 × 1 minute or 24 minutes.

If the total process requires less than 24 periods for its completion, the Uniselector switch can be made to " home " rapidly.

The features above take up two banks of the eight available in the Uniselector switch, leaving

six to control the six output relays which are connected to operate the machine movements.
The Edison Swan Electric Co. Ltd., 155 *Charing Cross Rd., London, W.C.*2.

Airmec Electro-Magnetic Mechanism.—This mechanism has been designed to transmit mechanical torque to a spindle when the electro-magnet is energized. The angle of rotation of this spindle without gearing is 7°. An alternative linear motion is also provided by an extension of the armature assembly.
Airmec Ltd., High Wycombe, Bucks.

The Sunvic Hotwire Vacuum Switch.

Hotwire Vacuum Switches.—To overcome arcing in electrical relay systems hotwire vacuum switches have been introduced. The principle on which these switches operate is that when an electric current is interrupted by the separation of two surfaces in a vacuum no arcing occurs. As the separation therefore need only be very small it can be actuated by the thermal expansion of a wire through which the control current is passed.
Sunvic Controls Ltd., Templefields, Harlow, Essex.

Impregnation Recorder.—These instruments contain an electronic control unit and a four-point linear chart-recorder with indicator. One record on the chart gives a measurement of the insulation resistance by means of an electronic circuit whose potential does not exceed 200 volts D.C. A second record is of capacitance which is valuable as a criterion for air and gas entrapped in the insulation. The measurement is carried out by means of alternating current at the mains frequency. The third record is of the temperature in the impregnating tank and the fourth record is of the vacuum by means of a hot-wire Pirani gauge using a stabilized electronic circuit.
Addison Electric Co., Ltd., 10–12 *Bosworth Road, London, W.*10.

Variac Regulating Transformers.—The Variac is an autotransformer consisting of a single winding on a toroidally-shaped core. Contact between the winding and the load circuit is made through a carbon brush which covers at least one turn of wire at all times. The contact surface, which with copper wire oxidizes at the elevated temperatures under the brush, is of an alloy of precious metal thus giving a very long life to the transformer. Various designs for different operating conditions are available.
*The Zenith Electric Co., Ltd., Villiers Road, London, N.W.*2.

Pneumatic Pressure Transmission.—These systems measure pressures up to 20,000 p.s.i. and 30 in. vacuum and comprise a transmitter complete with indicator. Pressure indications are transmitted by means of low pressure air over distances up to 1,000 ft. The transmitter consists basically of a gauge actuated by the pressure to be measured and shaft-connected to a transmitting unit that precisely controls the pressure of low-pressure transmitted air in direct proportion to the shaft movement of the gauge.
*Dewrance & Co., Ltd., Gt. Dover Street, London, S.E.*1.

Steam Heat Controllers.—Besides a very wide range of steam traps, sight glasses and other steam control equipment Spirax-Sarco Ltd. produce temperature controllers of the liquid expansion type where the hydraulic force acts directly upon the regulating valve. This principle is also applied to the liquid blending instruments or automatic diversion valve for re-circulating liquid.
Spirax-Sarco Ltd., Cheltenham, Glos.

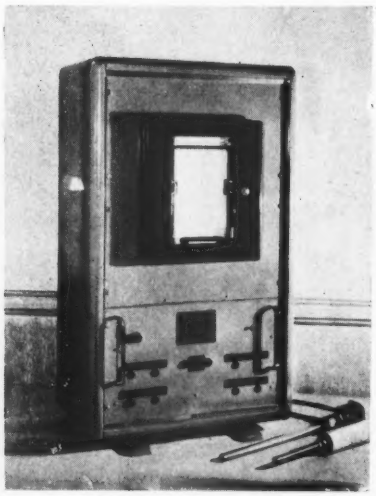
Steam Pressure Control System.—This system is made up of three parts, the pressure controller, the relay and the servomotor. The controller measures variations in the signals to the relay which, through a switching valve which makes it possible to go over to manual control, sends the signal to the servomotor. The servomotor consists of a piston operating the valve lever by means of air pressure supplied to the appropriate side by the opening or shutting of a port. This is controlled by a ball rod actuated through a diaphragm by the pneumatic signal.
James Gordon & Co., Ltd., Dalston Gardens, Stanmore, Middlesex.

The Heenatron Drive Mechanism.—This drive mechanism has a wide and stepless speed range of automatic operation which is controlled to fine limits. The mechanism is made up of three units; the control box, the electronic rectifier, and the motor. The control box contains the stop and start buttons and speed regulating potentiometer. The rectifier unit operates on normal single phase A.C. mains supplying the D.C. for the motor. The unit employs mercury-vapour grid-controlled thyatrons. Governed by the generator on the motor, infinitely variable speeds down to 60 r.p.m. are available irrespective of wide variations in load. An adjustable torque limitation circuit protects the motor against overload. The D.C. shunt wound motor is rated up to 1 h.p. at maximum speeds of 2,800, 1,400 or 960 r.p.m. or alternatively geared motors are available. At the non-drive end of the motor a permanent magnet type A.C. generator is housed the voltage from it being directly proportional to speed.
Heenan & Froude Ltd., Worcester.

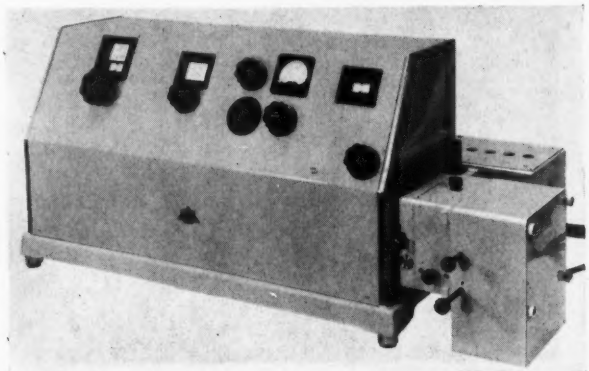
LABORATORY AND TESTING EQUIPMENT

Direct Reading pH Meter.—This instrument is capable of giving direct readings to better than 0·05 pH. The zero stability of the instrument upon which the accuracy ultimately depends is within 0·02 pH. under normal working conditions. These are two scales, one reading 0–14 pH. and the other giving a 7 pH. cover over any part of the scale. A millivolt scale is also included and automatic temperature compensation is provided to correct readings over the range 0° to 100° C.
Electronic Instruments Ltd., Richmond, Surrey.

Unicam Infrared Spectrometer.—Most plastic materials, particularly the ureas and formaldehydes, show strong light absorption characteristics in many spectral regions. Measurement of this absorption with the ultraviolet or visible spectrophotometer or with the infrared spectrometer enables the characteristic absorption curves of the different substances to be plotted, thereby making possible rapid and accurate qualitative and quantitative analyses. This is



(Left) The Addison chart impregnation recorder.



(Right) The Unicam S.P.500 Spectrophotometer.

particularly valuable for the testing of raw materials and for the standardization and quality control of manufactured plastics materials.

In research the method is used as a means of arriving at more detailed knowledge of the fundamental structure of the material under investigation. Absorption spectra are associated with molecular structure and give a permanent and detailed record of chemical composition.

The Spectrometer has been designed in basic form to fulfil industrial routine and process control functions for which a reliable double-beam instrument of compact and portable layout is required. Industrial or academic research, in which versatility of spectral range, resolution and recording speed is necessary, is made available by appropriate accessories.

Unicam Photoelectric Quartz Spectrophotometer.—This instrument is designed for the rapid identification, qualitative and quantitative determinations of chemical substances by the percentage absorption or transmission of light at wavelengths in the range 2000–10000 Å. *Unicam Instruments Ltd., Arbury Works, Cambridge.*

Dielectric Test Set.—This equipment is designed for the measurement of dielectric constant and power factor. The method of measurement is that of capacitance variation in a tuned circuit, a square law valve voltmeter being used as a detector of resonance. The test circuit comprises an interchangeable tuning inductor with oscillator coupling coil shunted by the test jig capacitance. The test circuit is loaded with the sample and the circuit magnification (Q) measured in terms of bandwidth, expressed in terms of variation of capacitance required to reduce the voltage across the tuned circuit to a certain proportion of the resonant value.

The sample of dielectric is then removed and the metal plates are brought nearer together until resonance is again established. The measurement of bandwidth is then repeated, with air as the dielectric. The total capacitance in the second case is equal to that in the first, and from a knowledge of the actual capacitances represented by the various condenser settings, the power factor of the sample may be calculated.

The thickness of the solid specimen under test should not exceed 5 mm., the preferred thickness being between 1 and 2 mm., with a diameter of 53 mm.

A jig for the measurement of the power factor of liquids is also available to special order (Type TJ 227). In the case of liquid specimens, the test procedure is reversed, the first set of measurements being made with the air as the dielectric and the second set with the specimen in position.

The Marconi Instruments Universal Bridge TF 868/1.

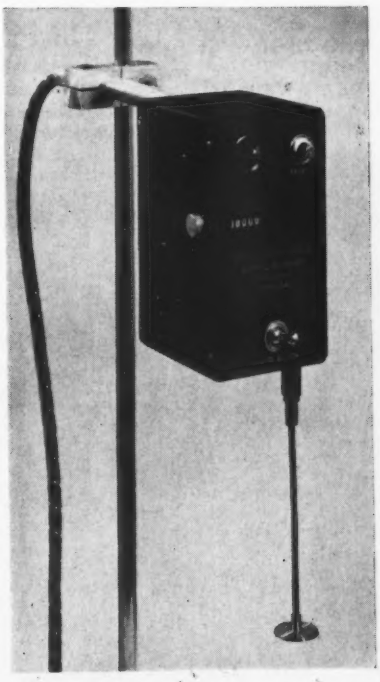
The TF 704B is suitable for plastics with power factors in the range 0·0001 to 0·1, which covers practically all known requirements.

Circuit Magnification Meter.—The TF 329G contains the necessary equipment for a variety of r.f. measurements by resonance methods, including the measurement of the dielectric loss of flat specimens of insulating material. A dielectric loss test jig is provided, and the measurement is made in the same way as with the Dielectric Test Set TF 704B, but the accuracy is not so high. Specimens up to 0·375 in. can be tested.

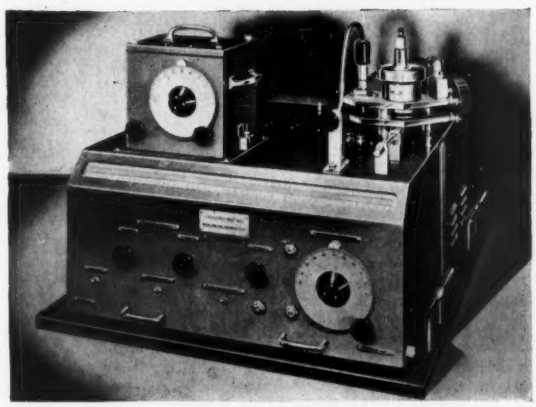
Universal Bridge TF 868/1.—Specimens of plastic can be tested with this instrument. A convenient method is to use the dielectric loss test jig. The specimen under test forms the dielectric of a condenser, and measurements are made at 1 kc/s. and 10 kc/s. in terms of capacitance and tan δ. For convenience, a chart is fitted to the top of the instrument and interrelates tan δ, Q and power factor (sin δ or cos ø).
Marconi Instruments Ltd., St. Albans, Herts.

Techne Viscometer.—This viscometer will measure the viscosity of liquids of 50 centipoises upwards with an accuracy of ±2%. A constant air pressure produced by a vibrated piston forces the liquid under examination along a horizontal glass capillary tube open at the far end. The time in seconds for the liquid to flow a marked distance along the tube is numerically equal to the viscosity in poises.

Gelation Timer.—The operation of the instrument is based on simple fundamental principles. A weighted disc immersed in the resin is subjected to a simple harmonic vertical motion, with a periodic time of one minute, by connection to a geared synchronous electric motor. As the resin sets a point is reached at which the stiffness is sufficient to support the weight of the disc during a 30 seconds half cycle; up to this point, the connecting link has been under tension both during the up and down strokes, but as soon as the disc is supported, the link on its down stroke becomes subjected to a compression causing an electric contact in the link to close a circuit. This in turn opens a relay irreversibly, stops the synchronous motor, and lights a small neon lamp, to attract attention. The gelation time is then read off in minutes on the counter and, after resetting, the apparatus is ready for another determination.
Techne (Cambridge) Ltd., Duxford, Cambridge.



(Right) The Techne Gelation timing instrument.



(Left) The Marconi Dielectric Test Set.

Vacuum-Cell Photometer.—The Baldwin Photometer consists of one or two vacuum photocells and a simple, compact mains-operated D.C. valve amplifier, fitted with an indicating instrument, range switch and zero control. The amplifier utilizes a symmetrical, balanced circuit; it is thus self-compensating for mains fluctuations and amplifier drift is practically eliminated.

Photo-emissive vacuum cells are used in which the incident light liberates from the cathode, photo-electrons which are then collected by the anode and passed to the amplifier.

Vacuum cells are available with a range of colour sensitivities, extending from the long infra-red, through the visible to the ultraviolet part of the spectrum.

Baldwin Instrument Co., Ltd., Dartford, Kent.

Impact Testing Machine.—Three types of machine designed to register maximum impact strengths of 1 ft. lb., 3 ft. lb. and 10 ft. lb. are available. The first two comply with BSS 771–1948 but the 10 ft. lb. machine is outside the range of present specifications. The pendulum of the machine has a striking velocity of 8 ft. per second, at the moment of impact and is fitted with a replaceable hardened steel striking edge of 0·125 in. radius. The amount of energy absorbed by the test specimen is given by direct reading in ft. lb. (or kg. cm.).

W. & T. Avery Ltd., Soho Foundry, Birmingham, 40.

Single Channel Oscillograph.—This oscillograph will record one variable and one time and has a 3½-in. tube and 1½-in. marker tube. The Universal camera with which it is fitted takes still shots of either recurrent wave forms or single-stroke phenomena, or it can take long lengths of record by continuous feed or short lengths at very high speed, on the drum. By adding suitable pick-ups and pre-amplifiers all kinds of measurements of pressure, force and strain can be made. It is also possible to use it visually. Other models range up to 12-channel oscillographs of either trolley mounted or fixed pattern.

Southern Instruments Ltd., Frimley Road, Camberley, Surrey.

Raymax Industrial X-ray Equipment.—The Raymax 140 X-ray equipment is used primarily for the examination either by fluoroscopy or radiography of plastics mouldings to check the position of inserts, to determine the presence of metal particles and to check that sound homogeneous components have been manufactured. The equipment consists of a high voltage generator, X-ray tube unit, and control panel. The high voltage generator is an oil-immersed transformer sealed with its associated rectifying valves and low-voltage valves and tube filament transformers in a sheet steel tank. The X-ray tube is oil-immersed and has water cooling coils within the casing to allow continuous usage. The control cabinet provides stepless adjustment of the kilovoltage applied to the tube, from 30 to 140 kVp.

Newton Victor Ltd., 132 Long Acre, London, W.C.2.

MISCELLANEOUS

Pegasus Electronic Digital Computer.—This computer which deals with numbers as a series of digits, can be made to work through, without human intervention and at high speed, problems which involve a large amount of calculation or which are of great length. It can also carry out a large number of simpler calculations of the same type.

To prepare a calculation or problem for the machine the requirements must be very precisely stated. A "programme" is then prepared embodying these and effecting them in terms of the facilities of the machine and the various operations which it can perform. Every step of the calculation is written in a numerical code. The programme is quite general in the sense that the instructions will apply to any data which may be given to the machine for the particular type of problem.

When one calculation is completed, the machine can be used for any other problem by giving it a different programme.

When the programme has been prepared and coded it must be put into a form which can be understood by the machine. With Pegasus the information is punched on to teleprinter paper tape and "read" into the machine by photo-electric cells. The different arrangements of holes on the tape convey the appropriate information to the computer.

When a calculation has been completed the results are presented by being punched on to paper tape, which passes on to actuate an automatic typewriter; the punch can operate more quickly than the typewriter, and this arrangement permits the most efficient use of the computer in applications when the results are presented in groups.

Ferranti Ltd., Moston, Manchester, 10.

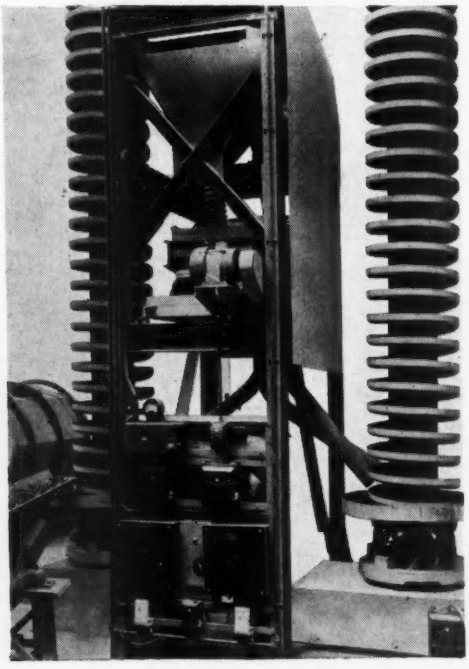
Hollerith Electronic Calculator.—The calculator will perform a full range of mathematical operations in any sequence predetermined by the instructions set on the machine. It can be used extensively in accounting, production and stores control.

British Tabulating Machine Co., Ltd., 17 Park Lane, London, W.1.

Vibratory Feeding Devices.—These devices offer several advantages over gravity feed devices in that the rate of feed is simply and accurately controllable, flow resisting materials can be easily handled, and material can be conveyed vertically, as in the spiral elevator. Another advantage which has been found when they have been used as a means of feeding granules into extruders is that their simple and open design makes cleaning an easy operation. Elevators, bowl feeders and channel feeders can be of individual capacity and design to suit special circumstances.

Valley Products (Lye) Ltd., Valley Road, Lye, Stourbridge.

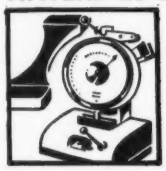
(Right) Vibratory spirals feeding grinders and sifting machines in the production of phenolic moulding powder.



(Below) The Pegasus Electronic Digital computer showing control panel, tape readers, and automatic typewriter.

World's Industry Employs Plastics

MATERIALS and TESTING



New methods for producing p.v.c. pastes.—T. Hugosson describes a new method in which coarse and fine fractions of p.v.c. powders are used to influence the viscosity of p.v.c.-pastes in dependency of the plasticizer content. Adversely, when using certain grain-size mixtures of the same p.v.c. material, pastes of the same viscosity can be obtained, the hardness of which varies with the plasticizer content. This seems to suggest the possibility of producing p.v.c. pastes for casting and painting with a reduced plasticizer content.
(*Kunststoffe*, 1956/July/342.)

Polymerization speed of unsaturated polyester resins.—A formula originally proposed by Berndsson and Turneen on the relationship between the polymerization speed of unsaturated polyester resins and the activity and concentration of the catalysator has been applied by P. Malthe and L. Damen to the polymerization process of one polyester resin using five different peroxide-catalysators. The values for the activity and influence of concentration obtained experimentally are critically reviewed.
(*Kunststoffe*, 1956/July/324.)

Evaluation of plastic tooling.—R. M. Houghton surveys the many modern applications of plastic tooling materials and enumerates in particular the advantages of plastic dies.
(*Tool Engineer*, 1956/Feb./218.)

Testing of plastic foils and artificial leather.—A German draft standard DIN 53382, dated April 1956, has been published, for testing the behaviour of the material under a one-sided flame action. An oscillating burner with a flame length of 40 mm and an opening nozzle of 0·5 mm is suggested, which is oscillated from a horizontal position to a 30° inclined position whereby the flame impinges a vertical plate covered with the material to be tested. The length of impingement is approximately 75 mm.
(*Kunststoffe*, 1956/July/330.)

Surface coatings—A review of the expanding American surface coating industry forms the subject of an article by J. E. Sayre. It is estimated that over 350,000 tons of synthetic resin are used in this industry, approximately half of which is phthalic alkyd resins and 12% styrene. Many interesting commodity changes have taken place and these are reviewed by the author who forecasts an increasing consumption of surface coatings within the next 10 years with a corresponding advance in technological achievements.
(*Chemical and Engineering News*, 1956/Aug. 6/3746.)

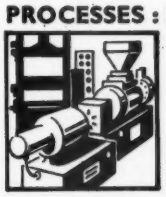
Petrochemicals.—M. Maret describes the different stages in the refining of crude oil with their accompanying by-products and the use to which these products are put in the manufacture of raw materials for the plastics industry. An interesting section deals with the make up of some of the natural gases to be found in France and their value as an alternative source of supply.
(*L'Officiel des Matières Plastiques*, 1956/July–Aug./21.)

Production of p.v.c.—A brief review of the production of p.v.c. polymer and the methods of polymerizing the vinyl chloride monomer to obtain specific properties is given by L. Bologna.
(*Poliplasti*, 1956/Mar.–Apr./11.)

Infra red spectro-analysis.—An article by N. E. M. Hagethorn and J. P. I. Van Kesteren deals with the infra red spectro-analysis of p.v.c. fillers. The article is amply illustrated with diagrams showing the spectrum with different types of fillers.
(*Plastica*, 1956/Aug./448.)

Mylar film.—Mr. D. D. Lanning gives a comprehensive survey of the physical, chemical and electrical properties of Mylar polyester film. An outstanding characteristic of this film is the retention of high mechanical strength over a wide temperature range. It remains flexible and stable from —60° C. to 150° C. and is highly resistant to many chemical reagents and solvents. Methods of fabrication are also discussed.
(*Product Engineering*, 1956/July/187.)

PROCESSES : MACHINERY



Metering equipment for resin.—Equipment is now available for continuous proportional metering of resins, including abrasive fillers hardeners of different viscosities, even for special applications at elevated temperatures. The range of ratios can be adjusted and two or more components be used.
(*Automotive Industries*, 1956/July/1/82.)

Ejectors with compressed air.—H. Gastrow describes several plastic moulds in which compressed air is used to eject the finished component. In one case mechanical ejection is combined with compressed air ejection.
(*Kunststoffe*, 1956/July/346.)

INDUSTRIAL APPLICATIONS

Plastic-clad metal.—A new aluminium-laminate combination permits light weight design on heavy duty hydraulic pistons, such as shock absorbing units for aircraft landing gears. The pistons are of 24 ST4 aluminium alloy to which a thermosetting phenolic laminate is bonded.
(*Machine and Tool Blue Book*, 1956/July/141.)

Vinyl laminating to metal.—The development of a new bonding technique enables vinyl film to be firmly fixed to metal sheets. C. F. Kiernan and A. J. Lombardi discuss the properties and applications of such a material and comment on its ability to withstand the abrasive action of a forming die when drawn or punched articles are made. Some of the criteria for the successful production of the laminate are given.
(*Product Engineering*, 1956/July/167.)

Epoxy faced dies.—Through appropriate reinforcement or formula modification, mechanical properties of epoxy plastics can be adjusted to meet particular metalworking requirements. Their use for forming and drawing an aircraft skin doubler from 0·040 in. aluminium is demonstrated.
(*The Tool Engineer*, 1956/July/84.)

MISCELLANEOUS USES

New uses of plastics in passenger cars are described by T. MacNew, who estimates that the 1956 car utilizes 15·25 lb. plastics compared with 10·4 lb. estimated a few years ago. The use of some plastics declined while new ones replaced them. The various plastics components in use are shown in the form of a table around a car illustration.
(*Automotive Industries*, 1956/June/15/58.)

Expanded resins for aircraft applications are being further developed. They are used in the manufacture of various radomes owing to their desirable electrical properties. A radome consists essentially of an inner and outer layer of glass fibre reinforced resin with a foamed-in-place middle layer giving necessary rigidity but allowing unrestricted passage of radar waves.
(*Automotive Industries*, 1956/July/1/48.)

Plastics at the International Spring Fair, Frankfort, 1956.—A short report is given of new developments seen at this well established Fair.
(*Kunststoffe*, 1956/July/318.)

Printed circuits.—Dealing with the different methods of making printed circuits as well as the different materials that can be used as conductors and base plates, this review provides one of the most comprehensive surveys yet published. Increasing use of this method of wiring is being found in electronic control devices for industrial machines as well as for the radio and television industries and it is with this former application that the survey is concerned.
(*Product Engineering*, 1956/Aug./167.)

Polyurethane standard.—Preliminary and tentative specifications and test methods for polyurethane foam materials are given with a view to receiving comments and suggestions from industry. The specification has been provisionally drafted by a sub-committee of the S.P.I. Cellular Plastics Division.
(*Rubber Age*, 1956/Aug./803.)

New Productions

(Left) A bird bath injection moulded in two parts by Mentmore Manufacturing Co. Ltd.

(Right) Police motorcycles fitted with Cobex aprons and Perspex windscreens.

Bird Bath

The "Genyk" bird bath, designed and produced by the Plastics Division of the Mentmore Manufacturing Co., Ltd. for Hygienic Wire Works Ltd., demonstrates the increasing use of polystyrene in equipment for cage birds.

The bath, measuring $3\frac{3}{4}'' \times 4\frac{1}{2}'' \times 5\frac{1}{2}''$, consists of two injection mouldings in transparent and ivory polystyrene joined by means of a locking device designed and patented by Mr. Peter Marshall, Manager of Mentmore's Plastics Division.

The transparent base has a "non-slip" interior surface and the lid, with its wide ventilation slots, has two hooks that clip on the side of the cage.

Dish Washing Machine Parts

A hard p.v.c. coating which withstands near-boiling water can be deposited from a p.v.c. paste developed by Vinatex Limited, using Geon p.v.c.

The paste which is applied by dipping, has been found suitable for coating the wire baskets used in the "Dishmaster" dish washing machine. This machine is designed to cope with up to 600 pieces of crockery and other kitchen utensils per hour. The baskets are thus exposed to heavy wear.

The Geon p.v.c. coating fulfils the double function of protecting the metal baskets against corrosion and helping to reduce the possibility of breakage.

The "Dishmaster" is made by Savage and Parsons Limited, Watford, p.v.c. paste made by Vinatex Ltd., Carshalton.

Plastics on Police Motorcycles

Birmingham City Police have adopted as standard equipment for their motorcycle police the plastics windscreen and apron which we show on the first three motorcycles to be fitted. The windscreen is formed from Perspex sheet supplied by I.C.I. and the apron from Cobex rigid vinyl sheet supplied by B.X. Plastics. The forming by heat and pressure is carried out by Feridox Ltd., 32 Frederick Street, Birmingham, 1.

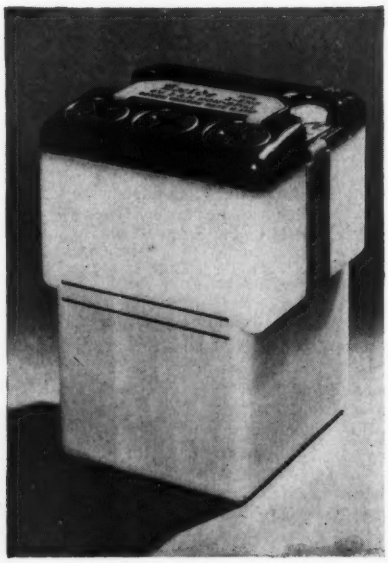
Motorcycle Battery

Owners of lightweight motorcycles and scooters can now see at a glance whether their batteries need topping up. The new Silver Exide 3-EN5 6-volt motorcycle battery, made by Chloride Batteries Ltd., Clifton Junction, Swinton, Manchester, is assembled in a multi-compartment container moulded in translucent polystyrene with maximum and minimum acid levels marked by two red lines on the side.

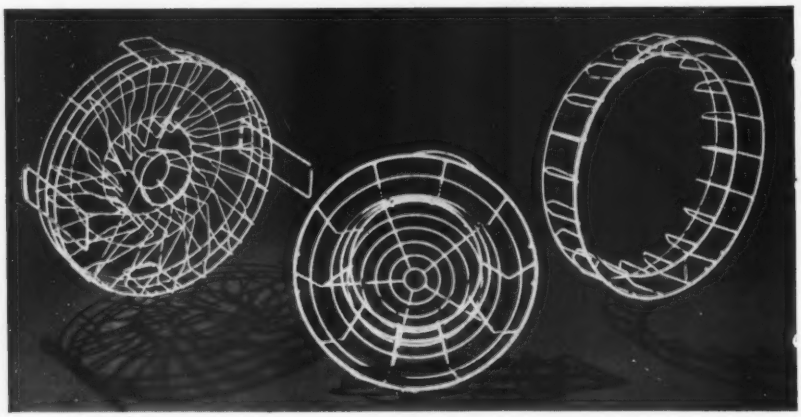
The new unit is also completely unspillable—an important feature on lightweights and scooters which may be turned on their sides for routine servicing. Each cell vents into a common chamber through a special baffle device. Gas then escapes from this chamber through holes in two of the filling sockets. This method of venting, in conjunction with the internal design of the cells, ensures unspillability in any position. The gas chamber has a red polystyrene cover on which operating instructions are moulded.

Filling holes are of sufficient diameter to permit easy topping up, which can be carried out without removing any cover. The screwed ebonite filling plugs have coin slots for easy removal. When screwed in place, the filling plugs are flush with the top of the battery.

Intercell connections are made internally through the cell partitions, reducing the weight and improving the exterior appearance. Rubber



(Above) Moulded polystyrene motorcycle battery box.



(Left) Washing machine parts coated with p.v.c.

gaskets between the cells and in the end walls of the container ensure that the battery is acid-tight.

Terminals are provided with screwed, cadmium-plated steel studs. They are remotely situated from the vents, and that part of the conductor not forming the contact area is protected by a cover of red polystyrene.

Double separation, consisting of sheets of microporous Porvic and glass wool is used. The separators provide complete immunity from short circuits, and act as a retainer for the active material in the plates. The 6-volt 3-EN5 battery has a capacity of 5 Ah.

Original artwork incorporated in wine table top.

Wine Tables

A gay series of still life paintings with a Mediterranean influence have been executed by Miss Phyllis Bray, member of the London Group, and incorporated in the Warerite plastics tops of a range of wine tables. Commissioned by Mrs. Horn of John Lewis & Co. Ltd., the signed originals were painted with the aid of special pigments and paper supplied by Bakelite Ltd., and incorporated in the table-tops during manufacture. Since the paintings are actually beneath the scratch-resistant surface, they are permanently protected from damage and can be kept clean and bright with the wipe of a damp cloth.

The tops of these wine tables, which have a height of about 14 in. and a diameter of 1 ft. 8 in., are neatly edged with a plain brass strip, and black steel legs with brass ferrules have been fitted. The tables are being retailed in the contemporary furniture department of John Lewis & Co. Ltd., Oxford Street, London, W.1.

The store is prepared to quote for the incorporation in similar table-tops of original paintings or motifs of any kind.

Vacuum Formed Plaque

The plaque which we illustrate on this page has been vacuum formed from Bextrene sheet which is an extruded toughened polystyrene sheet manufactured by B.X. Plastics Ltd. The printing which is in twelve colours has been done by the silk screen process and is carried out before forming. The vacuum forming has been done by Omega Plastics Ltd., Highbridge Rd., Barking, Essex.

Silk screen printed and vacuum formed plaque.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Winding Equipment

SIR,—We note with much interest the article on page 209 of *Plastics*, August, 1956, entitled "German Winding Equipment" and wish to draw your attention to the fact that we are the agents in this country for the manufacturers of the Alquist Winders.

We would like to amplify the information given in your article:

The regulator supplied with the Alquist Winder is purely a voltage regulator and is therefore not correctly described as a "take-up motion." This regulator adjusts the power in the winder to suit the speed of the material being wound up, and also the reeling tension required. There is no mechanical control, as the Alquist motor itself is designed in such a way that its torque increases as its speed fails; the motor is brushless and requires only a minimum of maintenance.

For machinery where the speed of the materials to be wound up varies a great deal, we supply a synchronous generator to be driven by the main process machine; this generator supplies current to the Alquist motor at a voltage and frequency which depend upon the speed of the main machine. The Alquist Winder therefore becomes self-adjusting for varying materials speeds as well as for the diameter of the reel.

INTERNATIONAL CORPORATION LTD.
1 Cornwall Road,
London, S.E.1.

Examination Questions

SIR,—It would appear from Question 3 in the paper reported on page 206 of your August edition that there is still a lot of ignorance as to the principles of high frequency and in fact if the question was as reported it would appear that the examiners themselves have but a faint knowledge of the subject!

High frequency heating is not used for the heating of moulds which is carried out at mains frequency as per the excellent articles by Messrs. Lorton and Craske.

Dielectric heating of moulding powder and induction heating of moulds are very different kettles of fish indeed!

S. R. HAWKINS.

Radio Heaters Ltd.,
46 Gray's Inn Road,
High Holborn,
London, W.C.1.

(EDITOR'S NOTE: The question referred to was correctly reported.)

Printing on Diakon

SIR,—Can you please help us to find someone capable of high quality printing on Diakon strips. Hot stamping is not satisfactory for our requirements. Batches will not be large and will vary from 200 to 1,000 or more.

THE ANDERSON INSTRUMENT CO.
15 Lingfield Road,
Wimbledon,
London, S.W.19.

Medicine Measures

SIR,—We shall be grateful if you will let us know if you can introduce us to any manufacturers of plastic medicine measures. It is essential that these should withstand boiling.

PHILIP HARRIS LTD.
144 Edmund St.,
Birmingham, 3.

Caravan Roof Lights

SIR,—Would you please be so good as to give us the name and address of the manufacturer who is already making the $21\frac{1}{2}$ in. $\times$ $21\frac{1}{2}$ in. $\times$ 3 in. $\times$ $\frac{1}{8}$ in. (inside measurement) transparent acrylic roof lights fitted to the top of a caravan. We require these in lots of 50 or so.

S. CAPLAN & SONS LTD.
447–453 Hackney Road,
London, E.2.

Plastics NEWS

Plant and Equipment, Materials, Processes, Company News, Technical Literature, Exhibitions, Personal Notes, and Meetings.

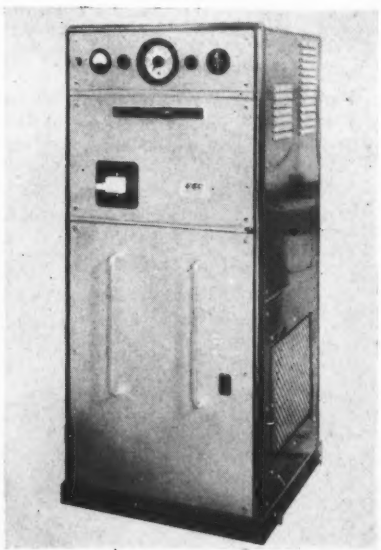
NEW INDUCTION HEATER. — The General Electric Company Ltd. has developed an induction heater having an output of 7 kW at a frequency of 500 kc/s. The features of this new generator make it equally suitable for use in repetition work or as a general purpose tool for processing batches of different articles.

The heater incorporates a fully variable control of output power, the heating inductor being fed from an output transformer whose secondary can be moved smoothly over the primary by a lever projecting from the front of the cabinet. The control allows optimum conditions to be set up for a wide range of applications and permits the use of easily constructed heating inductors. It enables maximum power to be maintained into a steel charge being heated to temperatures beyond the Curie point. The heating inductor operates at low voltage and is not therefore a source of danger to the operator.

Both the output transformer and the heating inductor are watercooled. The method adopted for making the watertight coil connections is both simple and effective enabling inductors to be interchanged very quickly so that different applications can be accommodated.

The high frequency output is obtained from an oscillatory circuit using a single reliable valve which is supplied from a full wave rectifier circuit using six rectifier valves. The circuits are well protected by relays and fuses. The oscillator valve and the interior of the set are cooled by a filtered air blast. An anode current meter gives an indication of the power output.

The heater is operated with push buttons mounted on a separate box for fixing in a convenient position on a work table. A self resetting process timer enables the heating cycle to be terminated automatically. Signal lights are used to show when the generator is idling and when in full operation.



(Left) The new G.E.C. Induction heating unit.

NEW TEST APPARATUS.—The new Model CET tester manufactured by Scott Testers Inc., 161 Blackstone Street, Providence, R.I., U.S.A., uses a controlled and variable twin-screw drive for the extension of the specimen. For hysteresis test, cyclic loading is accomplished automatically with instantaneous reversing at selected points of settings. To measure "plastic" flow, the drive can be locked in position and the decay in load can be plotted. Recording by means of electric weighing system, and complete freedom from inertia result in an accurate stress-strain evaluation.

The speed of the lower crosshead is instantly variable over a wide range and the load is also variable in the range of 0–2,000lb. accurate to within 0.25% of the selected load span. An additional feature is that a portion of the recorded stress-strain can be blown up so that it can be studied in greater detail.

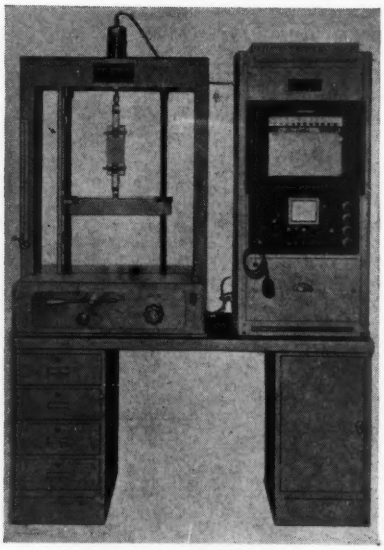
An improved model of the Mooney shearing disc viscometer has also been introduced by Scott Testers Inc.

VACUUM FORMING GROUP. — The British Plastics Federation has now established a Vacuum Forming sub-section of its Fabricators Group to cater for the interests of those who are engaged in this growing branch of the industry.

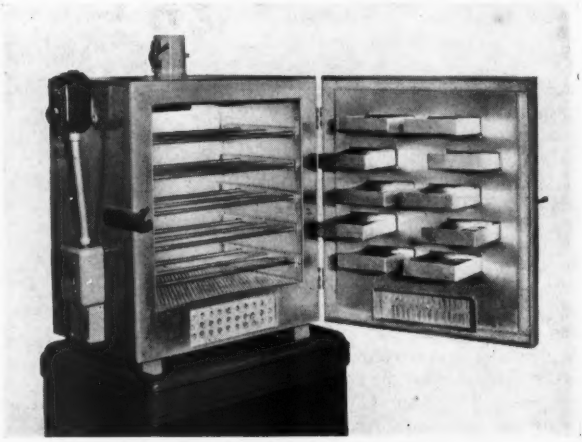
This step follows the recommendations of an informal meeting held on May 15 to which all companies interested in vacuum forming were invited.

PRE-HEATING OVENS.—A new design in pre-heating ovens has recently been introduced by Funditor Ltd., 3 Woodbridge St., London, E.C.1. The oven is of the air circulating type and is heated by 2 kW. electric elements controlled by a variable thermostat. The front of the oven is hinged but has ten drawers or containers let into it so that when working, the door need not be opened. The containers can be of sheet steel or perforated steel as required depending on the granular size of the powder to be heated.

Other larger ovens are available, one with fourteen drawers and also an oven designed for heating sheet material prior to forming. Full details can be obtained from the company at the address given.



The model CET Scott Tester.



(Right) The Funditor pre-heating oven with the front open showing the powder trays.

General

Sleeve Marking Service.—A new service has been started by Permark Service, Devon House, High St., Cranleigh, Surrey. This service enables firms to have any quantity of plastics or rubber tubing permanently marked and cut to length in order to form identification cable markers. The sleeving is supplied by the customer.

Research Fellowships.—British Oxygen have announced the award of the following fellowships for postgraduate research: Mr. C. M. George, B.Sc., of Bristol University, for research in the Department of Chemistry, Bristol; and Mr. N. G. Parsonage, B.A., of New College, Oxford, for research in the Inorganic Chemistry Laboratory, Oxford University.

Renewal of fellowships for a third year have

been granted to the following: Mr. B. F. Figgins, B.Sc., at Queen Mary College, University of London; Mr. D. H. Kirkwood, B.A., in the Department of Metallurgy, University of Cambridge; and Mr. R. D. McCammon, B.Sc., at the Claredon Laboratory, University of Oxford.

High Purity Primary Decyl Alcohol.—Primary decyl alcohol of a purity previously unavailable is being produced at the Texas City, Texas, plant of Carbide and Carbon Chemicals Company, a Division of Union Carbide and Carbon Corporation.

Due to improved production techniques, primary decyl alcohol will be sold under tighter specifications. Highlighting the specification changes are lowering of the maximum aldehyde content of the product from 0.20% to 0.05% and colour from 15 to 10 on the platinum-cobalt scale.

Burtonwood Engineering Co. Ltd. announce that they now build under licence the complete range of Andouart extrusion equipment. Literature, demonstrations and technical advice are available from the sole agents, Warbrick (Engineering Specialties) Ltd., Barclays Bank Chambers, Sankey Street, Warrington, Lancs.

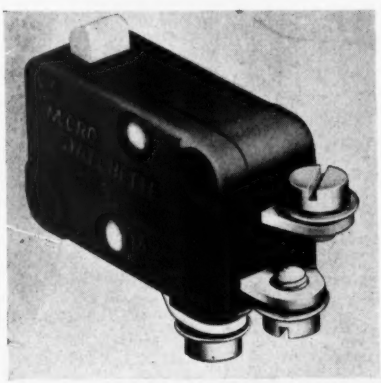
Thermotank Limited has formed a subsidiary to manufacture glass reinforced plastic tubes, rods, sheets and similar products in continuous lengths. The method used will be completely new and production will be designed for those industries which require corrosion resistant piping.

Reduction in price.—The price of Alkathene has been reduced by I.C.I. to 2s. 11d. per pound. This represents a reduction of 3d. per pound, the third price reduction within three years.

Film Service.—Mullard Ltd. are offering a series of films on various aspects of electronics suitable for presentation to a wide audience. The films have been made so as to explain some of the principles on which electronics work and are utilized. Further information can be obtained from Mullard Film Service, Publicity Division, 1 Gerrard Place, London, W.1. All films are available on loan free of charge.

Improved Micro Switchette.—An improved version of the well-known Burgess "V3" Micro Switchette is announced by Burgess Products Co. Ltd., Team Valley, Gateshead 11.

Made to the same general specification and dimensions as the present model, with which it is interchangeable, the improved "V3" has a nylon plunger in place of the phenolic resin plunger used formerly.



The Burgess V3 Micro Switchette

Company News

John Kimbell and Co. Ltd. have taken larger premises at 39 Victoria St., Westminster, London, S.W.1. Telephone No. Abbey 7193.

Dallow Lambert & Co. Ltd. have moved their London office to 6 Stratton St., London, W.1. Telephone No. Grosvenor 4766.

Elk & Co. Ltd. have opened a showroom at 237 Kensington High St., London, W.8. Telephone No. Western 1212.

Erinoid Ltd.—Negotiations have now been completed whereby Petrochemicals Ltd., a wholly-owned Shell Chemicals subsidiary since March, 1955, acquires Erinoid's 40% holding in Styrene Products, which thereby becomes a wholly-owned subsidiary of Petrochemicals.

Mr. L. H. Williams will remain as Chairman and Mr. P. C. Chaumeton as Managing Director of Styrene Products Ltd.

Erinoid Limited will continue to sell Polystyrene and Polystyrene derivatives manufactured by Styrene Products Limited, under the existing trade name of Erinoid.

The Hercules Powder Company Ltd. announce that by mutual agreement with Messrs. Algemene Kunstzijde Unie, N.V. of Arnhem, Holland, it has been decided to terminate as from July 31, 1956, the present arrangements for the distribution of Akulon polyamide moulding granules and rod material.

After July 31, 1956, Messrs. B.X. Plastics Limited, Chingford, London, E.4 (Telephone No. Larkswood 5511), will take over these activities.

The Minerva Detector Company Ltd. have moved to new premises at Lower Mortlake Road, Richmond, Surrey. Telephone No. Richmond 6431.

The Pascall Engineering Co. Ltd. have moved to new works, at Gatwick Road, Crawley, Sussex. Telephone No. Crawley 25166.

Compagnie Francaise de Raffinage, a French petroleum refining and processing organization, announce the purchase of a 2-million-volt Van de Graaff particle accelerator for basic research from High Voltage Engineering Corp., Cambridge, Mass., U.S.A.

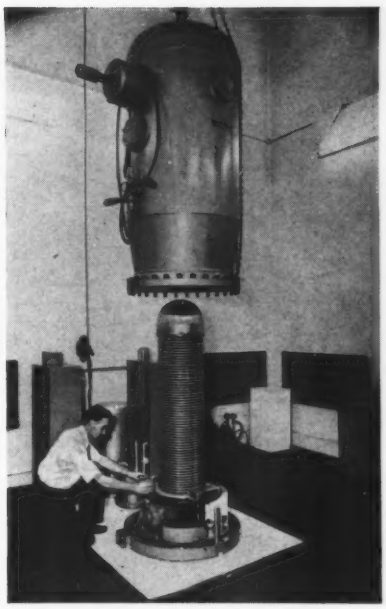
Dunlop Research Centre.—A new, specially designed, laboratory for the irradiation of rubber and plastics has been completed at The Dunlop Research Centre, Birmingham. A planned scheme of research into the effects of irradiation on rubber and plastics will now be put into operation, special emphasis being made on the investigation of polymerization and vulcanization by gamma rays.

Initially investigations will be carried out with a 100 curie source of cobalt 60, obtained from Harlow and later a full source of about 1,000 curies will be used.

The R.F. Development Co. Ltd. have moved to a modern factory at Priory Lane, St. Neots, Hunts.

Exhibitions

The Shoe and Leather Fair, which is being held from October 1 to October 5 at Olympia, will include on the stand of Monsanto Chemicals Ltd., the first British made styrene-butadiene copolymers to be commercially available to the British shoe and soling industries. They will go under the trade name of Tred 50 and Tred 85 and have been developed as rubber reinforcing agents for resin rubber, semi-expanded, and microcellular solings.



Van de Graaff installed at Standard Telecommunications Laboratories, Ltd., for research into insulating materials.

Fuel Efficiency Exhibition.—This exhibition will be held in the National Hall of Olympia, London, from October 2 to October 10.

R. H. Cole & Co. Ltd., in conjunction with J. M. Steel & Co. Ltd. are holding an exhibition and demonstration of plastics raw materials for injection moulding and extrusion, produced by Farbenfabriken Bayer AG. Admission is by invitation which can be obtained from R. H. Cole & Co. Ltd., 2 Caxton Street, London, S.W.1.

Utrecht Trade Fair.—At the "Vochema '56" to be held from October 9 to October 17 in Utrecht exhibits will be of the latest machinery for the food processing industry, the chemical and pharmaceutical industry and the dairy industry.

Plastics Exhibition.—The National Hall as well as the Grand Hall has now been booked for the international exhibition to be held from July 10 to July 20, 1957. This now gives a total floor area of 250,000 sq. ft. as compared to the 90,000 sq. ft. occupied in 1955.

Conferences

Symposium on Extrusion.—A symposium on Extruded Rubbers and Plastics is to be held at the National College of Rubber Technology, Holloway Road, London, N.7, on October 30 and 31, starting at 10 a.m. The symposium will be under the chairmanship of Sir Miles Thomas and will include papers by many well known authorities on this subject. Application forms can be obtained from the organisers, *Rubber and Plastics Age*, 147 Grosvenor Road, Westminster, London, S.W.1.

Colour Symposium.—Readers are reminded that application should be made as soon as possible for the Oil & Colour Chemists' Association's Symposium entitled "Some

Mr. E. J. Westnedge, recently appointed to the board of British Resin Products Ltd.

At the Yorkshire Section, Plastics Institute dinner-dance. L. to R.: W. K. Crawford, F. Kidd, J. Thwaites, Dr. C. G. Addingley, N. A. Gardiner, T. S. Kirkby, F. Cass, D. E. A. Russell, and L. A. Quevatre.

Implications of Colour " which will take place on Thursday, September 20, 1956, at University College, Gower Street, London, W.C.1.

The titles of the papers to be given will be " Colour Gamuts of Pigments " by E. Atherton and D. Tough; " Assessment of Light Fastness " by J. G. Gillan and " Personal Experience with the Inter-Society's Colour Council Aptitude Test " by Hess.

No application for tickets can be accepted after the first post on Monday, September 17, 1956.

Application forms can be obtained from the General Secretary, R. H. Hamblin, Oil & Colour Chemists' Association, Memorial Hall, Farringdon Street, London, E.C.4.

1957 National Plastics Conference.—Plans for the 1957 Annual National Conference of The Society of the Plastics Industry Inc. to be held in Los Angeles, California, next year, were formulated at a meeting scheduled by James Prior, Chairman of the SPI Pacific Coast Section on August 22 in that city. Also at that time plans were advanced for the proposed Pacific Coast Plastics Exposition to be sponsored by the Society.

Personal

Mr. C. S. Dingley, executive director of British Industrial Plastics Ltd., last month completed 50 years' service with his firm, having started in 1906 as a works chemist when the firm was the British Cyanides Co. Ltd.

Mr. Dingley is also a director of the Streetly Manufacturing Co., and B.I.P. (Tools) Ltd., and sales director of B.I.P. (Chemicals) Ltd.

Mr. Dingley was one of the founders of the Plastics Institute and its first vice-chairman. He was chairman in 1937 and chairman of the British Plastics Federation, 1952–3 and 1953–4.

Mr. E. J. Westnedge, general sales manager of British Resin Products Ltd., has been appointed to the board of that company.

Mr. G. Dodd, director and general manager of Monsanto Plastics Ltd., is to be controller of Purchases, Monsanto Chemicals Ltd.

Mr. E. L. Pixton, sales controller of Monsanto Chemicals Ltd., and a director of Monsanto Plastics Ltd., will, until further notice, be seconded to devote the whole of his time to promoting the present and future marketing interests of Monsanto Plastics Ltd.

Mr. B. Sellers has been appointed sales manager of Flexile Metal Co. Ltd.

Mr. R. F. Archer, joint general manager of Micanite & Insulators Co. Ltd., has been elected to the board of directors. **Mr. H. N. Sporborg** has resigned from the board.

Mr. W. A. Coates has retired from the board of Metropolitan-Vickers Electrical Co. Ltd. He will continue as Commercial Consultant to the Managing Director until the end of the year. Mr. Coates has also resigned from the boards of the following M-V subsidiary companies: Metropolitan-Vickers-GRS Ltd., Newton Victor Ltd., and Sunvic Controls Ltd.

Mr. F. S. Haggerson, of U.S.A., has resigned from the board of Bakelite Ltd., for reasons of ill health. **Mr. G. C. Wells,** of U.S.A., has been appointed a director to fill his place.

Mr. L. E. Moore has been appointed sales manager of the Electronics Division and the Leocast division of Lion Electronic Developments Ltd.

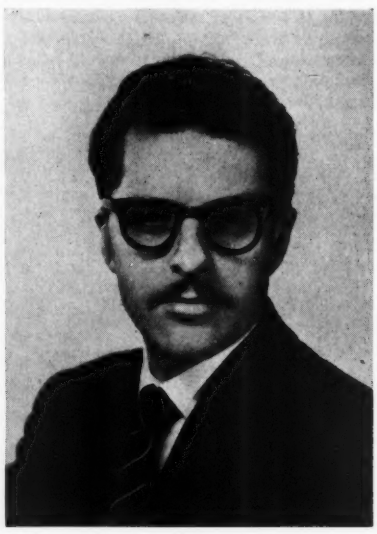
Col. R. L. A. B. Morten.—We regret to announce the death of Col. R. L. A. B. Morten, who has been for many years a well-known figure in the plastics industry. Col. Morten was a director of Crystalate Ltd. and also of Mica Products Ltd., British Homophone Ltd., and Ebenestos Industries Ltd. He had been a director of Crystalate Ltd., since 1928.

Mr. F. W. Gilling.—We regret to announce the death of Mr. F. W. Gilling, formerly buyer of The Ruberoid Co. Ltd., for 37 years until his retirement in 1947. Mr. Gilling, who was 73, leaves a widow, daughter and two sons, including Mr. F. J. Gilling the present manager of the company's purchasing department.

Mr. R. M. Viney.—It is with regret that we learn of the death of Mr. R. M. Viney, who with Mr. T. Bourdillon the Everest climber, was killed by a fall in the Swiss Alps on Sunday, July 29, 1956.

Mr. Viney was the youngest son of Col. O. V. Viney, Chairman of Messrs. Hazell, Watson & Viney Ltd., and he was at the time of his death Sales Manager of B.X. Plastics Ltd., for p.v.c. sheet products.

(Left) Charles Waghorne, managing director of Insulators Ltd., presented his trophy to Mr. W. A. Evans, of Dunlop Special Products Ltd., at the July meeting of the P.I.G.S. at Sunningdale.



(Right) Mr. L. E. Moore, appointed a sales manager to Lion Electronic Developments Ltd.

The Properties and Testing of Plastics Materials—Part 6 Cont.

Sections 6-11—Volatile Loss, Degree of Polymerization and Cure, Fungus Resistance

By A. E. LEVER,* A.I.R.I., and J. RHYS,† M.Sc.

Section 6. Volatile Loss, Migration, Blocking, Vapour pressure

Volatile Loss

ACTIVATED carbon is used as the immersion medium (1). Comparisons can only be made between materials having the same thickness. For cellulose acetate butyrate plastics the weight loss is determined by heating in a circulation air oven (2). Other materials are dealt with in the appropriate American specifications:—polyvinylidene chloride (3), non-rigid polyvinyl chloride acetate (4), non-rigid polvinychloride (5), and ethyl cellulose (6).

Migration of Plasticizers

When a plasticizer molecule in a polymer plasticizer system reaches the surface of the material it may volatilize, remain on the surface, or move to some other material with which the system is in contact. Migration may be accentuated by inclusion of an incompatible plasticizer, or of more plasticizer than the polymer can tolerate. Exudation, as distinct from migration may occur under these conditions, especially when exposed to ultra-violet light and heat.

A method is proposed (7) for determining the amount of plasticizer migration based on the weight loss of a sample after heating at a low temperature with silica powder in a closed jar. This method showed appreciable migration of polyester type plasticizers which show little or no migration by the usual methods. High oil absorption of the silica does not necessarily determine its suitability for this test. Linde silica (finely divided precipitated silica) and hydrated silica (100 mesh) were the only two found practical. A small percentage of basic lead silicate, ethyl cellulose or silica gell inhibits.

An investigation into the various factors influencing migration of plasticizers from polyvinyl chloride acetate copolymers is reported (8). For example the resistance of the stagnant air film should be measured.

The oil extraction method is described (9), and consists in immersing a disc 3 in. in diameter and convenient thickness in mineral oil at 50° C. for 4 hours, and measuring the weight loss. If the loss is over 10% the test is repeated and the measurements are repeated at one hour intervals. The mineral oil should be of specific gravity 0.845–0.865 at 25° C., and viscosity 25–35 cps. at that temperature.

$$\text{oil extraction constant } K \times \frac{w_1 - w_2}{a\sqrt{t}}$$

w_1 = original weight in gm. w_2 = weight after immersion.
a = area (both sides and edges) in sq. metres.
t = time of immersion in hours.

The migration of plasticizers from cable insulation is measured (10). A sample of the cable is taken and measurements of power factor made before and after heating in air at 70° C. for 168 hours.

Blocking

Blocking is the adhesion between touching layers of a material which occurs under moderate pressures during storage or use. Migration of the plasticizers may be an important factor. Both American (11) and British (12) specifications for testing flexible polyvinyl chloride sheet are similar in character.

Blocking is often judged by estimating by hand testing the amount of adhesion between the sheets and is reported as

N.B.—no blocking. No adhesion between sheets which slide freely.
V.Sl.B.—very slight. Sheets do not slide freely, but will do so on application of a slight force.
Sl. B.—slight. Sheets have to be peeled apart, but surfaces are intact.
B.—blocking. Sheets have to be peeled apart and surfaces are damaged.

Vapour Pressure

The vacuum evaporation technique for metallizing plastics has now become established. The gases released by the plastic material, or by the lacquer, make it difficult for the pumping equipment to function efficiently. There is a study of the degassing properties of some plastics (13). The method of Hogg and Duckworth (14) is used and consists of measuring the ratio between the vacuum pressures obtained in a chamber when it contains a test sample of standard size, and when it is empty. There are some useful tables giving:—(i) the vapour pressures of some plastics; (ii) vacuum properties of several plastics.

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Section 7. Degree of Polymerization of Thermoplastics, and Degree of Cure of Thermosetting Materials

Degree of Polymerization

ONE of the most simple methods for determining the degree of polymerization of thermoplastics is by viscosity determinations. The viscosity of a solution of a thermoplastic varies according to the degree of polymerization. Procedure and mathematical relationship will be found in any standard text book, e.g.:—(1) (2) (3) (4) (5) and (6). Publications are very numerous, (7) (8) (9) (10) (11) and (12) are representative. For control work an Ostwald or Ubbelohde type of viscometer is perhaps the best. The Ubbelohde eliminates the need for density data since the flow occurs under carefully controlled air pressure. Control work can be standardized under any suitable conditions, e.g. 5% solution at 20° C.

With a plastic such as polyethylene which gives a viscous melt, the melt viscosity can be used as a measure of the molecular weight. A variation on this theme is used in (13) and (14).

Polychlorotrifluorethylene needs special methods. One based on the flow is given in (15), but variations based on the strength of the melt are more popular. (16) determines the "no strength temperature," and (17) the "zero strength time."

Other methods of determining molecular weight, and so degree of polymerization are of more academic interest. These include methods based on osmotic pressure (1) (2) (3) (4) (5), sedimentation (1) (2) (3) (4) (5), light scattering (1) (2) (3) (4), sound velocity measurements (2). Molecular weights have also been determined by chemical analysis of end groups (1) (2) (3) (4) and by the use of tracer atoms (2).

Degree of Cure of Thermosetting Materials

The cure of phenolic resins can be followed by acetone extraction. Six hours is recommended (18). For moulded phenolic products the acetone extract should be considered solely as an expression of some property associated with degree of cure. There is no rigorous relation between optimum properties and the numerical value of the acetone extract (19). The amount of acetone soluble matter is affected by:—(i) nature of resin and filler, (ii) lubricant, (iii) moulding temperature, (iv) time of cure, (v) thickness of section from which sample taken, (vi) nature of moulded piece, (vii) technique used in moulding, (viii) distribution of fines, (ix) method of grinding specimen.

Studies of changes of attenuation and velocity of ultrasonic waves during the cure of thermosetting plastics may permit determination of the stage of polymerization (20). Nevertheless it has been reported (21) that at low frequencies the changes are too small to measure, and that at high frequencies (ca. 10 mc.) burning of the specimen takes place.

Deflection studies (21) using a standard heat distortion jig proved satisfactory for measuring the degree of cure of phenolic mouldings.

With urea formaldehyde mouldings the state of cure can be determined by boiling in a 1% aqueous sulphuric acid solution for ten minutes (22). An exact quantitative determination of cure is very difficult.

For melamine formaldehyde mouldings a dye staining technique is used (23). When

* Consultant. † F. W. Berk and Co. Ltd.

melamine mouldings are immersed in a boiling dye solution, the dye is absorbed by the moulding to an extent dependent on the state of cure.

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Section 8. Density, Specific Gravity, Bulk Factor, Thickness

Density and related properties

THE American specification (1) defines (i) apparent density as the volume occupied by a known weight of loose powder. (ii) Bulk factor as the ratio of the volume of any given quantity of loose powder to the same material after moulding.

This compares with the British Specification (2) in which (i) Apparent density is the weight in gm. of 1 ml. of powder. (ii) Bulk factor is obtained by dividing the density of the moulded specimen by the apparent powder density.

In addition to the methods quoted above, methods are given in (3) for measuring the density of cellulose esters, the variation in density of cellulose acetate with acetyl content, and similar variations in mixed esters are discussed.

The apparent density and bulk factor of a granular moulding powder is covered by specification (4).

Thickness

An informative article (5) discusses the measurement of the thickness of soft vulcanized rubber, and has interest to those requiring to measure the thickness of soft plastics. It is noted that the apparent thickness is highly dependent on the conditions under which it is measured. The two main factors which govern thickness readings on a dial gauge micrometer are the non-parallelism of the foot and table, and the pressure exerted by the foot.

A useful instrument known as the Elcometer is used widely for measuring the thickness of non-metallic coatings, including plastics, on iron or steel bases (6).

A high frequency tester of porosity and thickness of non-conducting materials is described (7). It consists of a valve oscillator and the voltage is set according to the thickness of the coating. The variant intensity of light from the valve visibly indicates thin and porous patches.

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Section 9. Tackiness, Angle of Slide, Flaw and Crack Detection

Tackiness

THE Dunlop Research Centre has recently developed a simple portable hand operated instrument (1). This enables tackiness to be measured easily and quickly over large areas of the material without damage.

A drying time recorder for measuring the drying characteristics of paints, adhesives, etc., is described (8). The recorder is placed on a wet film, and the electric timing motor rotates at a speed of one revolution per 24 hours, during which a weighed spherical pin impinges on the film and scribes an arc-shaped pattern until the film has dried. The drying time is noted where the pin no longer leaves an impression on the film.

A Hard Drying Time Tester for paints, lacquers, etc., complying with Ministry of Defence Specification D.E.F./1053-Method No. 8, is illustrated, with brief details (9).

The Atlas Tack Tester (or Zapon Tack Tester) is described (10), and the significance of the test is evaluated (11).

Angle of Slide

This test was developed in an investigation of flexible table top materials (2). Two specimens, 4 in. by 24 in., were cemented to wood blocks. Two standard sliding surfaces were produced and used as inclined friction machines. A standard load was applied, and the angle of tilt necessary to initiate sliding was observed.

Flaw and Crack Detection

A fluorescent ink for detection of cracks in metals and plastics has been developed (3). The ink is flowed or brushed on to the suspected part, and excess wiped off. When inspected under ultra violet light the cracks reveal themselves by their brilliant green fluorescence.

An article on defects in polythene welds (4) includes a spark test for porosity, and a radiographic method for detecting flaws.

Ultrasonics can be used for crack detection (5). Detailed accounts of the theory and methods of application of the technique are given (6) and (7).

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Section 10. Static Dust

A TECHNIQUE for observing static dust is described (1). An insulated oven is used with a slow speed blower in one corner. Humidity, temperature, and amount of dust introduced can be controlled. The investigation was confined to polystyrene wall tiles.

A portable instrument for measuring the voltage and charge of electrostatic charges on surfaces is described in (2). The instrument will measure voltage gradients of from 100 to 300,000 volts per foot.

References

1. *Mod. Plast.*, 1951, **28,** No. 9, 95.
2. Static Elect. Confr. Inst. Physics, 1953, or J. Sci. Instr., 1954, **22,** 149.

Section 11. Resistance to Fungus and Rodents

THE elimination or reduction of moisture in a plastic will automatically control fungus growth. Moisture, especially when combined with dust and fungus growth will cause electrical failure. According to (1) complete elimination of fungus growth from a surface for its service life is not a practical proposition. The effect of mould growth on electrical properties is reported (2) (3). Polystyrene gives erratic results. The effect of fungus growth on the tensile strength of plasticized polyvinyl chloride is investigated (4), and susceptibility of various plasticizers to fungus growth is discussed.

Resistance to micro organism attack on plywood adhesives is investigated (5).

(6) investigates "funginertness," the complete inability to furnish any nutriment to fungi. This report uses the Shake Flask Incubation method in which inoculation with Aspergillus Versicolor was followed by a 7-day incubation in a shaker at 30° C. In the table of results given, all copolymers, i.e. internally plasticized polymers, were resistant to this treatment.

Tests for rodent repellant chemicals for vinyl films are described in (7). Trinitrobenzene was found to be effective.

References

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2. A.S.T.M. Bull., 1950, No. 168, 53.
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4. *Prod. Eng.*, 1951, **22,** No. 12, 158.
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6. *Mod. Plast.*, 1954, **31,** No. 11, 111.
7. *Mod. Pack.*, 1952, **25,** 130.

Dutch Plastics Institute Ten Years Old

After its establishment in September, 1946, the Plastics Research Institute T.N.O. has undergone ten years of continuous expansion, in which this relatively young institute has clearly proved itself and become one of the largest departments of the well-known Central National Council for Applied Scientific Research (T.N.O.) in the Netherlands.

Having started its activities with a staff of 10 people the institute at present employs nearly 180, including some 20 graduates.

The activities of the institute of course are directed primarily to the Dutch plastics industry which it serves as a centre of information, as a consultative body and occasionally even as an extension of its research facilities.

Patent Review

The following abstracts have been made from specifications at the Patent Office, with the permission the controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 0d. each (including postage).

B.P. 749,961. Scoring rack for table games, particularly games requiring concealment by individual players of the obverse faces of playing pieces allocated thereto. J. Brunot (U.S.A.).

To retain the small rectangular blocks or tiles employed in playing crossword or other such games. The rack is preferably cast or moulded of plastic material.

B.P. 749,968. False ceiling and lighting screen construction. The Benjamin Electric Ltd. (U.S.A.).

The construction refers to buildings having a fire extinguishing sprinkler system. The ceiling is composed of thin translucent rectangular panels with parallel corrugations and made of Vinylite. Under the weight of the water the panel is supposed to yield and so to expose the sprinkler system and also to discharge the collected water with greater effect.

B.P. 749,969. Production of laminated magnetic cores. Vacuumschmelze A.G. (Germany).

Mechanical stress is produced on a laminated magnetic core by the introduction of a plastic material (an ethoxyline resin) between the laminations. The " instability " (variation of permeability) is then greatly reduced.

B.P. 749,975. Tube closures. W. Stofferegen.

A dome-shaped inner member and a complementary dome-shaped cap with outlets near their axis of rotation. The inner member consists of polyethylene inserted with tension so as to adhere with suction on the inner surface of the cap.

B.P. 750,099. Fluid filters. To: Eaton-Williams (Millbank) Ltd.

The filter consists of cloth supported by spaced rods in a frame. The frame may be made of a polyester resin with a filler and a hardening catalyst readily cast or moulded around the rod ends and the filter cloth edges. This solves the previously encountered sealing problem.

B.P. 750,239. Production of porous thermoplastic polymers. E. M. O'Conor-Honey, C. R. Hardy. To: Pritchett & Gold & E.P.S. Co. Ltd.

Thermoplastic polymer powder is fed as a layer on to an endless metal conveyor belt travelling between upper and lower sources of radiant heat at such a temperature that the heat can penetrate to the middle of the layer without causing excessive surface temperatures. No feed pressure and no vibration must develop in order to maintain sintering conditions. Subsequent soaking in plasticizer and then heating gives a more flexible product. Used for filtering purposes, in aircraft panel structures with bonding spacers (multicellular materials), in composite structures of a sponge-like material with sintered material for surgical splints to be shaped in situ.

B.P. 750,247. Automatic discharging cigarette case for containing and dispensing cigarettes. H. Lamb.

B.P. 750,342. Elastic staple element strip. Speed Products Co. Inc. (U.S.A.).

A staple element belt made from a thin continuous plastics layer in which the staples are linked together to be formed into a roll.

B.P. 750,551. Spectacles. M. Garson, N. W. Chappell.

With removable attachments on pins outstanding from the spectacle frame. Each attachment may be provided with slots for engaging the pins.

B.P. 750,629. Manufacture of moulded articles from polyamides. W. Costain, N. Fletscher, B. J. Habgood. To: I.C.I. Ltd.

Incorporation of small amounts of trimesic acid or an amide-forming derivative thereof into a polyamide-forming composition modifies the polyamide for shaping by extrusion or injection moulding.

B.P. 750,645. Flame spraying polyethylene and polyethylene-base materials. To: Union Carbide and Carbon Corp. (U.S.A.).

For applying polyethylene or mixtures containing, e.g., 90% polyethylene and 10% isobutylene to metal surfaces. The powder to which anatase (TiO_2) is added is projected in a surrounding stream of air heated to polyethylene fusing temperature against the surface to be coated. This surface is preheated to 300 to 425 deg. F.

B.P. 750,651. Electrically illuminated decorations. To: Luma Norsk Glodelamefabrikk A/S. (Norway).

Made from two halves of polystyrene glued together. A tubular piece at one end of the decoration (star) permits the introduction of a conventional bulb carrier and bulb attached to a cap to be pushed over the outer end of the tubular piece.

B.P. 750,737. Ornamental beads and like bodies. G. R. S. Charles. To: Chelton (Poppits) Ltd.

The beads are moulded from polythene and are provided with an integrally moulded head on one side and have a socket opposite the head so that a string can be made up by forcing the heads into the sockets by snap action. The head has play in the socket to provide flexibility.

B.P. 750,786. Watch cases. A. Gisiger. (Switzerland.)

A watertight case with a bell-shaped crystal (transparent plastics) with a removable back.

B.P. 750,808. Inkholders. J. Braithwaite & Son (Drysalters) Ltd.

The change of ink level in the holder is utilized in a float never containing more than a " safe " quantity of ink.

B.P. 750,912. Stoppers for cocktail shakers and the like. M. A. Hassid, E. Venis. To: British Vacuum Flask Co. Ltd.

The body part of the stopper, a hollow cylindrical column, is a nylon moulding, to which another moulding forming the pourer is attached.

B.P. 750,926. Spectacle frames. F. O. Wheway.

Retaining pieces from a clear and transparent plastic material on each brow bar engaging notches in the lens for securing the lens to the frame.

B.P. 750,981. Apparatus for the injection of molten thermoplastic material into moulds. T. Dymsza, M. A. Burdin.

Refers to the outlet valve with a greatly enlarged outlet in which slides a cylindrical valve stem. The valve opens when the projecting valve stem is pushed back on contact with the mould. The valve stem has exterior passageways separated by guide wings through which the molten plastic passes.

B.P. 750,991. Smokers' ash receptacles. J. Neale and Sons Ltd., M. R. Neale.

A casing (for attachment through a suction cup to a motor car panel) is covered with a flexible sheet bearing a design and/or printed matter, its ends being secured by adhesive strip to underneath and interior parts of the casing.

B.P. 750,993. Slip lasted shoes. E. T. Halliwell.

A sheet thermoplastic toe-puff is attached to the inner surface of the flexible upper set at its toe portion.

B.P. 751,017. Water-vapour-permeable composite leather-like sheets. To: E. I. Du Pont de Nemours & Co. (U.S.A.).

A porous structure is obtained by associating liquid-swellable fibres and initially thermoplastic polymeric binder material. Examples given for a textile fibre which may be nylon or rayon, wool, polyethylene, terephthalate, and for a binder of polyethylene or plasticized vinyl chloride/vinyl acetate copolymer.

B.P. 751,052. Dimensional stabilization of oriented thermoplastic films. J. W. McIntire. To: Dow Chemical Co.

A portion of the tubular film is inflated between spaced sets of pinch rolls and subjected to radiant heat while being moved on.

B.P. 751,068. Process for blow moulding thermoplastic hollow articles and a device for heating the thermoplastic material. T. Loew. To: Kraft Foods Co.

The plastic sheet is heated non-uniformly so that those areas designed to be stretched to a greater extent will be heated to lesser degrees of temperature than the areas to be stretched to a lesser extent. The result is that part of the stretch takes place in areas normally to be stretched less and the article, e.g., a cup, can be blown from thinner material and is obtained with more uniform thickness.

B.P. 751,069. Device for hanging up cakes of soap. H. Cossec (France).

A frame (ring; horse-shoe) with pointed prongs is inserted in the soap and forms a permanent holder to be slipped over a hook so that the soap hangs free in air in the best position for drying.

B.P. 751,080. Luggage carrier. To: Sociètè du Caoutchouc Normand (France).

A carrier for the roof of a motor car which can be folded in sections for transport and storage. The carrier members may be made of any material. The members are provided with rubber feet to fit the curve of the car roof.

B.P. 751,097. Lawn sprinkler hose. To: United States Rubber Co. (U.S.A.).

The hose portion is made from plasticized polyvinyl chloride as an integral unit by extrusion. The hose has a flat bottom serving as a support to orientate the jets of water issuing from the arcuate top wall. An inner partitioning structure reinforces the tube in longitudinal direction.

B.P. 751,203. Piston made of plastic material for a syringe for hypodermic injections. M. Berthiot (France).

An expandable piston of polyethylene. An outer piston tube is expanded to obtain a tight joint between piston and unground glass syringe barrel by a compression piston screwed into the inner piston tube.

P.P. 751,204. Folding door. M. A. Collet (Canada).

A plurality of light, rigid panels connected by hinges formed from a vinyl plastic sheet material covering both sides of the plates. The transparent or translucent sheeting may have been treated for decoration by the depositing of colour and flock on one side. Such material is sold under the trade name " Kalistron."

B.P. 751,211. Tooth brush. H. Magel (Germany).

With a two-part hollow handle one part of which holds a teeth cleaning liquid conveyed to the bristles of the other part through a capillary channel (add. to: B.P. 728,343).

B.P. 751,234. Reflex reflector particularly for road vehicles. R. P. H. Hinds.

The holder engages only the periphery of the transparent reflector plate.

B.P. 751,264. Carrier and dispenser. To: Zippo Manufacturing Co. (U.S.A.).

For carrying small cylindrical objects such as flints for cigarette lighters. A main body holding the flints in a channel and a dispensing rotatable disc with a radial slot closing the channel, are both moulded from a plastic material.

B.P. 751,267. Stocking suspender clip. E. Küchler (Germany).

Frame and slidable clamping member are provided with parallel grooves and projections in such a way that material of greater elasticity can be used.

B.P. 751,298. Curler combs. F. J. Coakley, A. A. Coakley.

B.P. 751,314. Apparatus for moulding plastic material and ejecting the moulded articles. L. F. Kutik (U.S.A.).

Especially useful for moulding articles like a brush integrally with its bristles. The ejector pins are arranged in two sets and are operated differently during the ejecting cycle.

B.P. 751,339. Manufacture of bags. T. E. Piazze. To: Continental Can Co. Inc.

The flattened tube of flexible polyethylene or polyvinylidene film is fed to the heat sealing device. Adjacent to each transverse heat seal are formed rows of punctures across the tube so that a mass of bags is produced separable one from the other by tearing along the rows of punctures.

B.P. 751,351. Method and apparatus for producing and treating films of thermoplastic material and the resulting product. P. J. Massey (U.S.A.).

Surface defects in high molecular weight thermoplastic material (polyethylene, vinyl resins, " Saran ") are eliminated by the application of heat to the film surface so that the heat causes the surface to " flow." As these materials, especially " Saran " are poor heat conductors the temperature of one surface may be raised to above 450° C. without affecting the other side of the film.

B.P. 751,367. Receptacle for dish-mop, cleaning brush and any handle-carrying articles. To: " Etablissements C.M.P." (France).

Consists of a base and two enclosing parts. The parts are moved into the closed position around the article under the weight of the inserted article and open up automatically on removal of the weight by lifting the article.

B.P. 751, 407. Container for keeping beverages hot or cold. P. J. Kircher. To: Landers, Frary & Clark.

An inner shell moulded from a heat resistant plastic material (urea-formaldehyde or phenol-formaldehyde resin) is provided with an overhanging flange having a groove underneath into which a gasket is fitted with a slot for receiving the upstanding rim of the inwardly directed flange of the outer shell, the bottom of which is screwed to a boss underneath the inner shell. The space between the shells is filled with heat insulating material.

B.P. 751,422. Pouring spout. To: Victorian Diemoulders Proprietary Ltd. (Australia).

To be attached to a container by forcing the enlarged inner end portion into an appropriate opening.

EXAMINATION QUESTIONS IN PLASTICS TECHNOLOGY

A further selection from the 1956 Associateship Examination Questions

ASSOCIATESHIP EXAMINATION 1956
GENERAL SECTION.
(i) USE OF ENGLISH.
(*Time allowed* 3 *hours.*)

Candidates should answer:—
(*a*) Questions 1 **and** 2,
(*b*) Questions 3 **or** 4,
and (*c*) Any three other questions.

The maximum number of marks obtainable for each question is shown in brackets.

1. Write an essay of about 450 words on ONE of the following subjects:—
   (*a*) Restrictive Practices in Industry.
   (*b*) The Government's Schemes for Further Technical Education.
   (*c*) Automation and its Problems, Economic and Social.
   (*d*) Plastics in Shipbuilding.
   (*e*) Cyprus, Britain and the Free World. (40)

2. Write a prècis of the following passage in about 150–160 words (i.e. about half its present length):—

At the top of the main staircase in University College, London, there stands a box-like structure of varnished wood, somewhat larger than a telephone booth, somewhat smaller than an outdoor privy. When the door of this miniature house is opened, a light goes on inside, and those who stand upon the threshold find themselves confronted by a little old gentleman sitting bolt upright in a chair and smiling benevolently into space. His hair is grey and hangs almost to his shoulders; he wears a cutaway coat (green, if I remember rightly, with metal buttons) and pantaloons of white cotton, discreetly striped. This little old gentleman is Jeremy Bentham, or at least what remains of Jeremy Bentham after the dissection ordered in his will—a skeleton with hands and face of wax, dressed in the clothes which once belonged to the author of *The Principles of Morals and Legislation.* To this odd shrine I paid my visit of curiosity in the company of one of the most extraordinary, one of the most admirable men of our time, Dr. Albert Schweitzer. Many years have passed since then, but I remember very clearly the expression of affectionate amusement which appeared on Dr. Schweitzer's face as he looked at the mummy. " Dear Bentham," he said at last, " dear Bentham! I like him so much better than Hegel. He was responsible for so much less harm." The comment was unexpected but true. Hegel was the spiritual father of those Marxian theories of history, in terms of which it is possible to justify every atrocity on the part of true believers and to condemn every good or reasonable act performed by infidels. Shallow with the kindly and sensible shallowness of the eighteenth century, Bentham thought of individuals as real people and not as mere cells in a social organism whose soul is the State, and from his shallows have sprung the repeal of antiquated laws and almost everything sensible and humane in the civilization of the nineteenth century. (20)

3. Discuss the following:—" The *adjectives* a man uses show his *taste*, the conjunctions he uses show his *logic*." Bring out clearly the meaning of the words in italics. (10)

4. Rewrite in good English:—
   (*a*) All three Governments have now requested Paris to be chosen as the place of meeting.
   (*b*) As his custom was the Secretary was often in the habit of frequently consulting his Chairman.
   (*c*) A Sèvres vase sold yesterday at Christie's for what is believed to be the record price of 4,000 guineas.
   (*d*) There being shown to be something fundamentally wrong in the cash department led to the appointment of an investigator.
   (*e*) My feelings, Sir, are moderately unspeakable and that is a fact. (10)

5. What qualities are required in a Training Officer of a large concern? Draft an advertisement calling for applications for such an appointment in a Plastics firm. (10)

6. Write notes on any three of the following:—
   (i) The British Council.
   (ii) The British Productivity Council.
   (iii) The National Trust.
   (iv) The Fine Art Commission.
   (v) U.N.E.S.C.O.
   (vi) The F.B.I. (10)

7. What are the arguments for and against the creation of another Second Chamber in place of the House of Lords? (10)

8. " Sport in this country has become more of a business than a game." Comment on this statement. (10)

9. The Chancellor of the Exchequer has spoken of the " debasement " of the currency since 1947. What did he mean? What remedies has he proposed? What other remedies have been suggested?

10. What are the best books to study in order to prepare for this examination in English? Give your reasons. Besides reading these books should candidates prepare in other ways? What ways do you recommend? (10)

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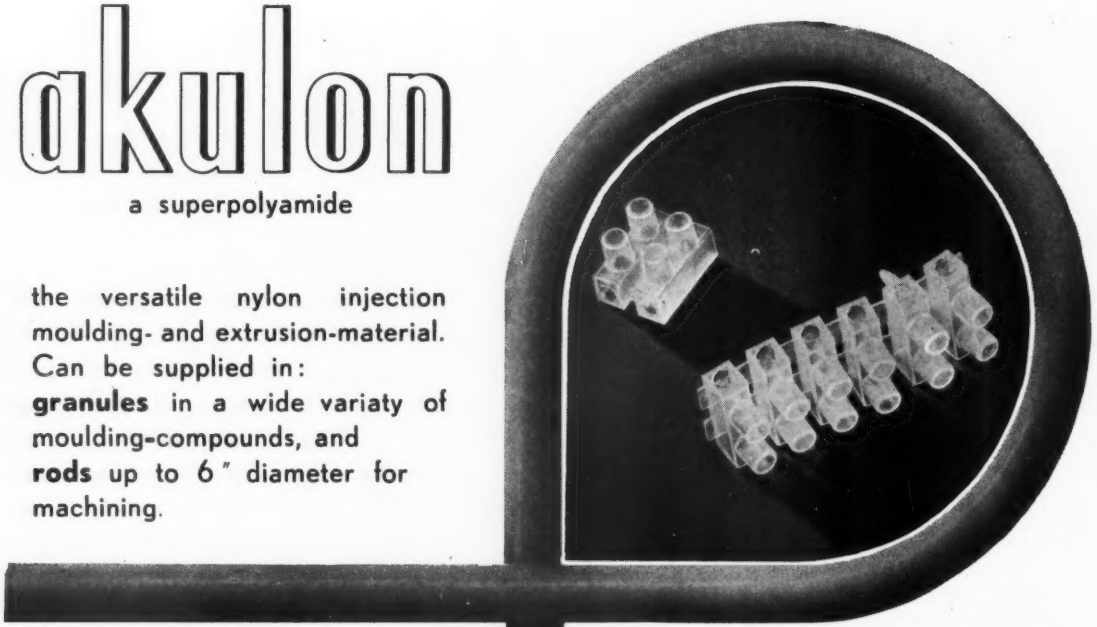

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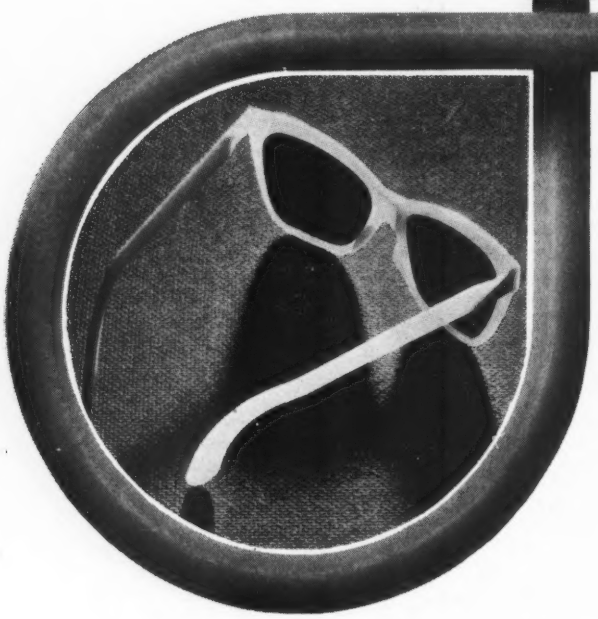

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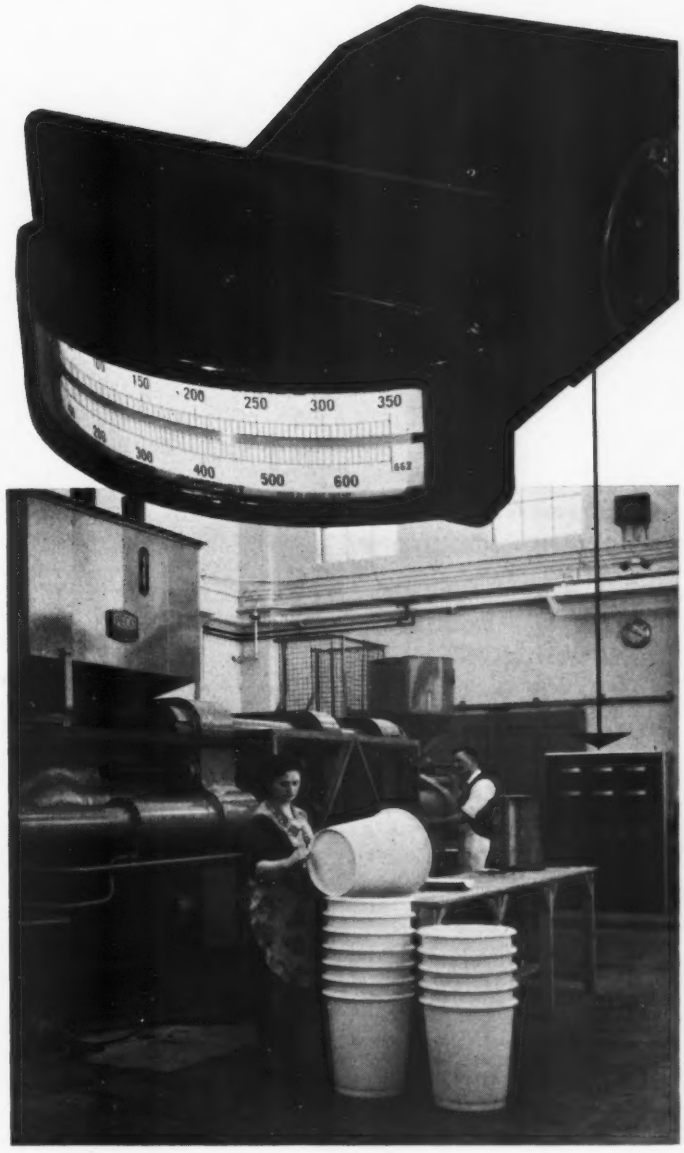

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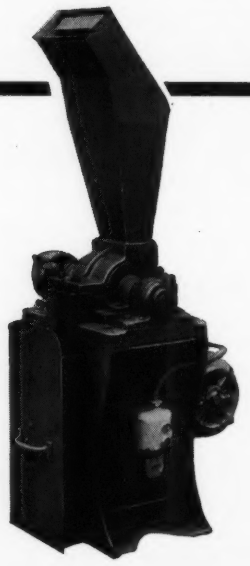

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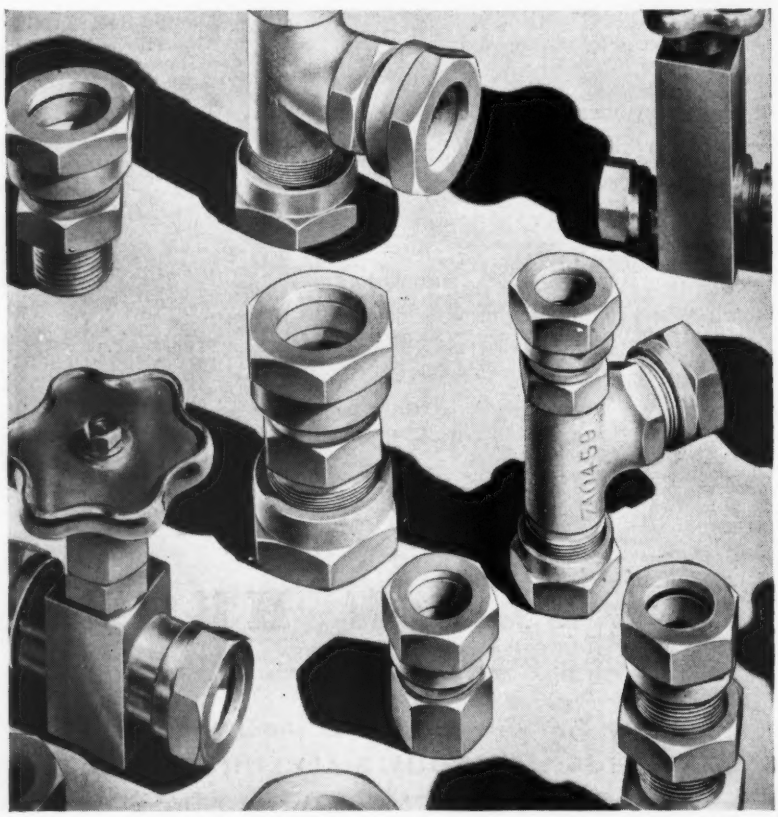

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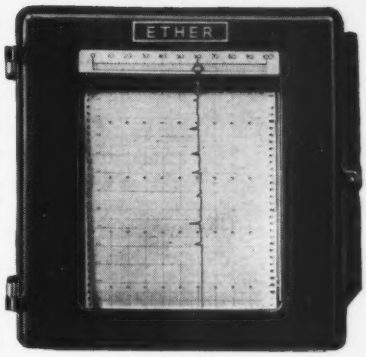

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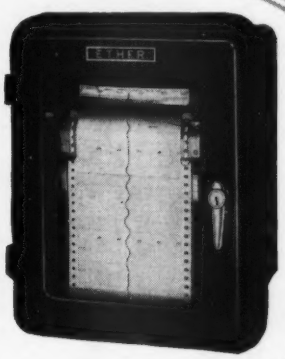

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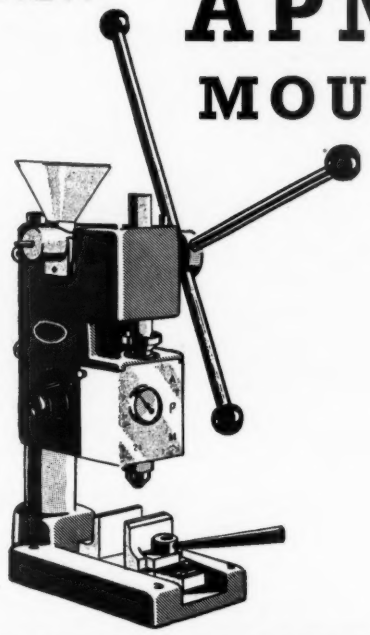

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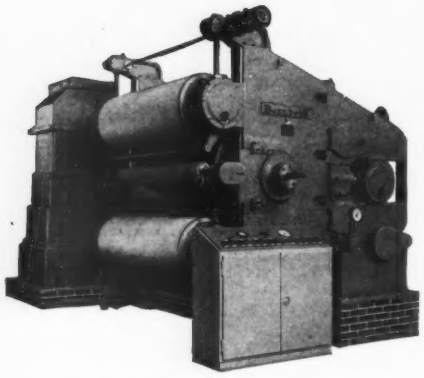

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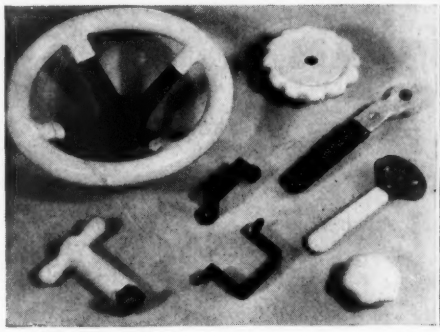

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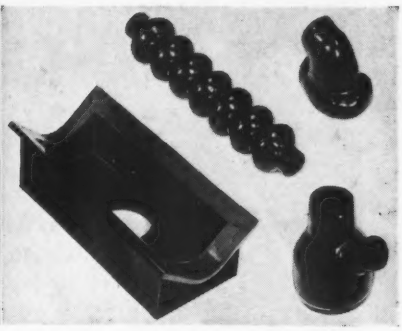

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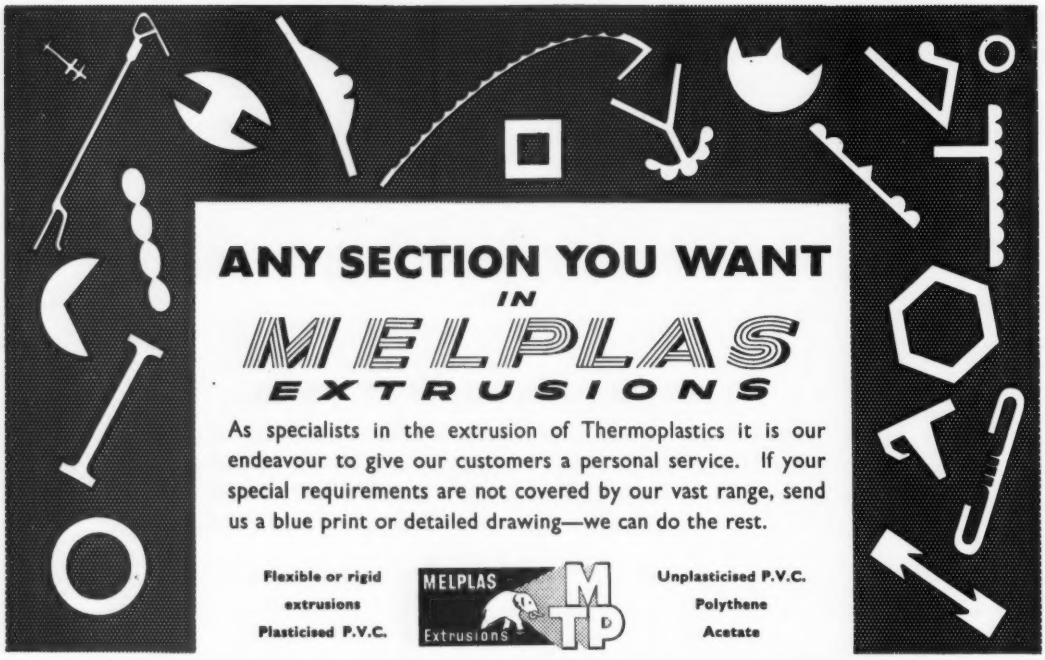

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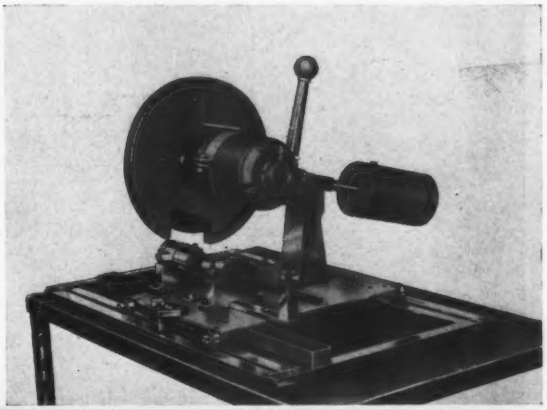

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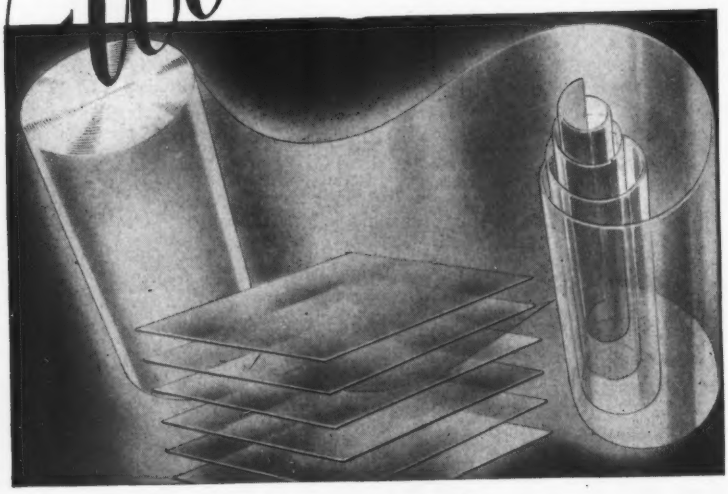

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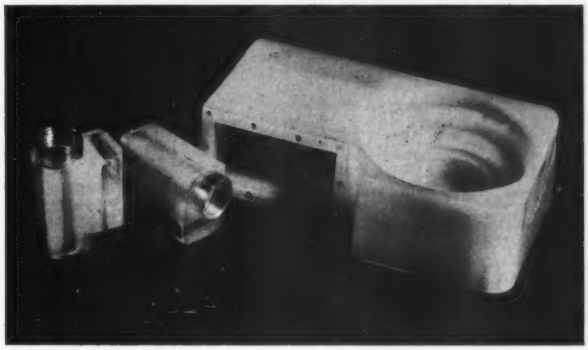

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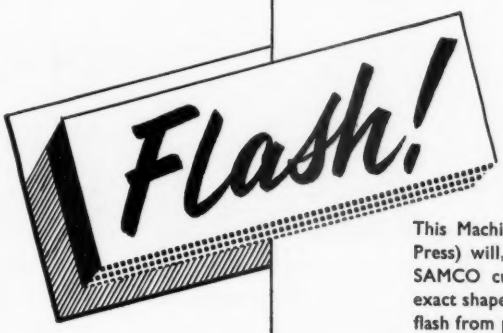

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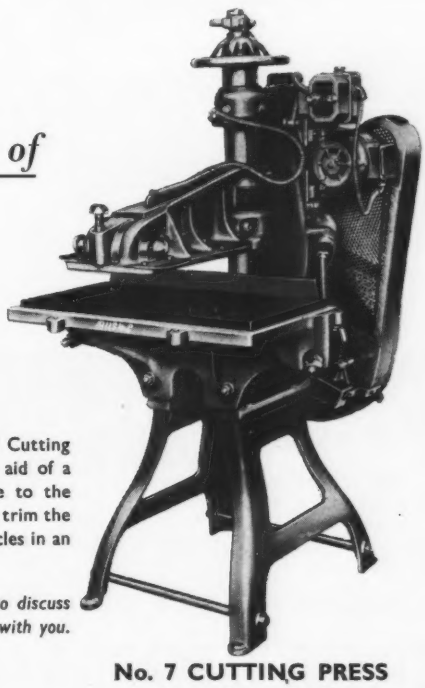

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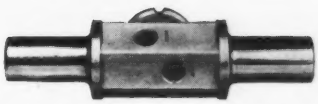

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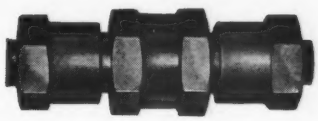

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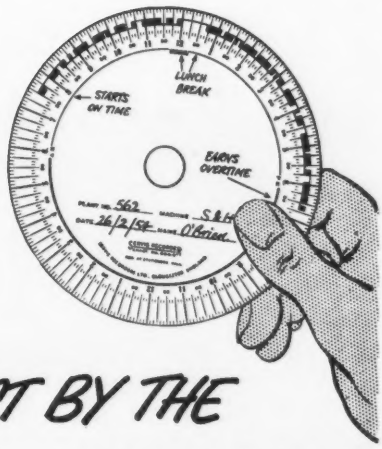

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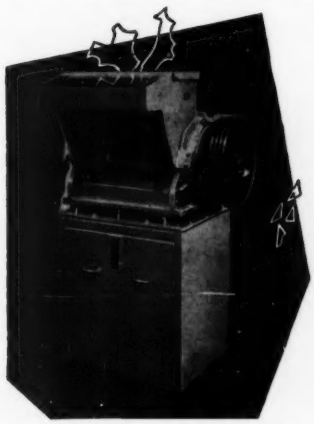

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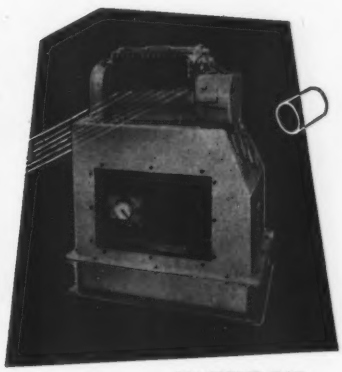

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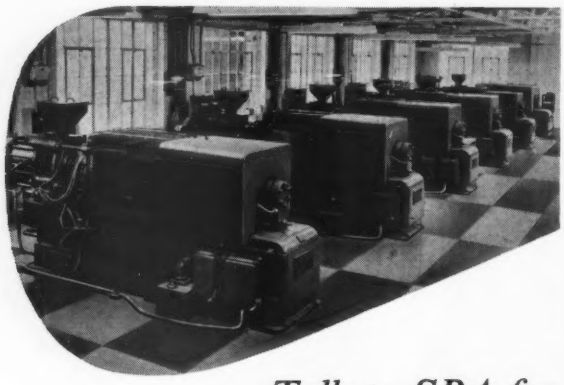

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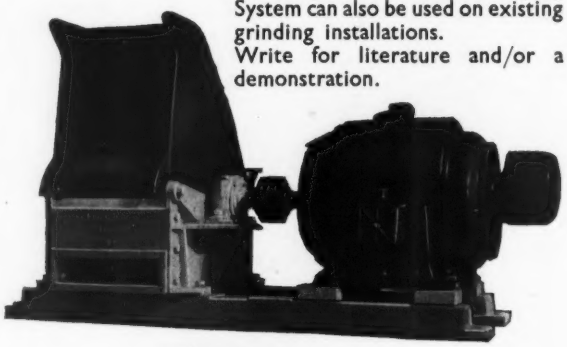

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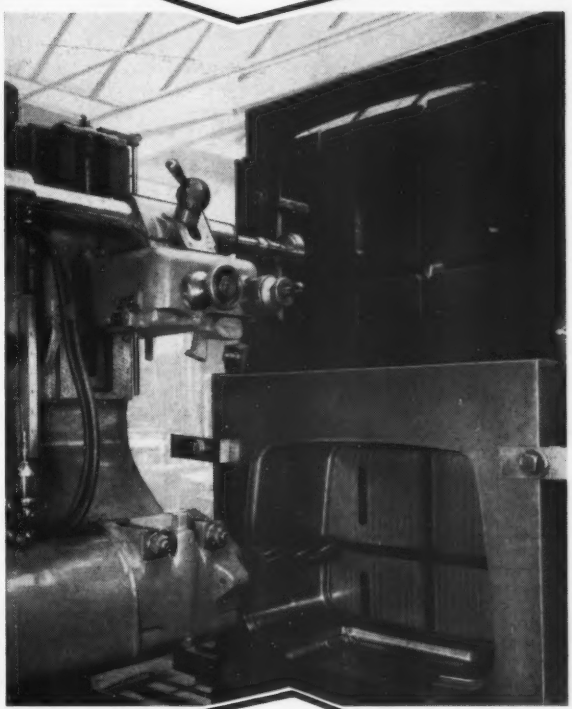

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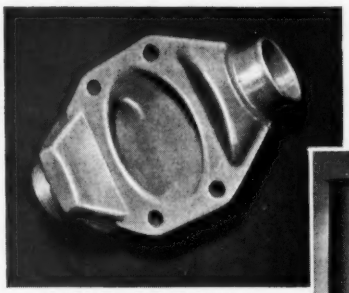

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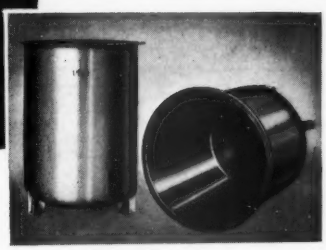

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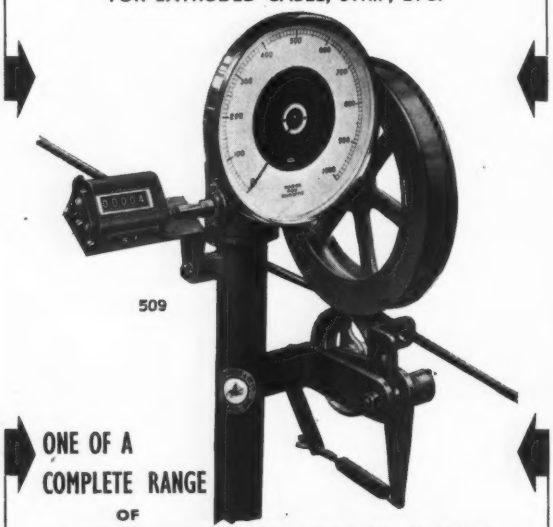

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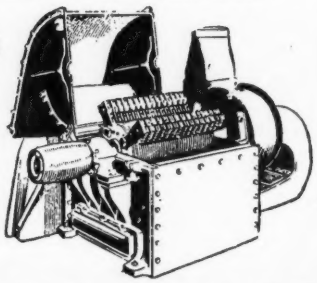

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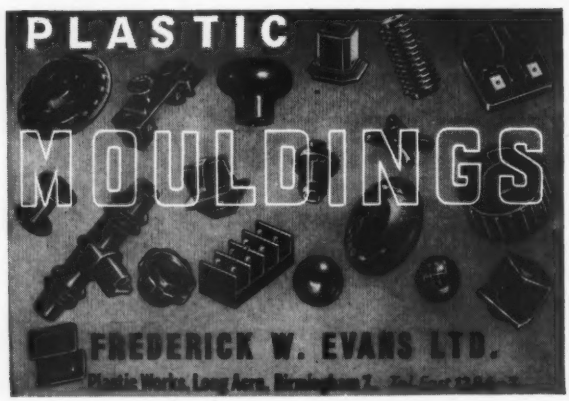

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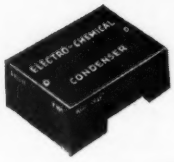

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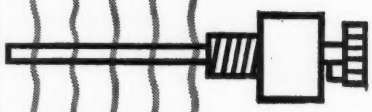

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'Tenite' is a registered trade-mark

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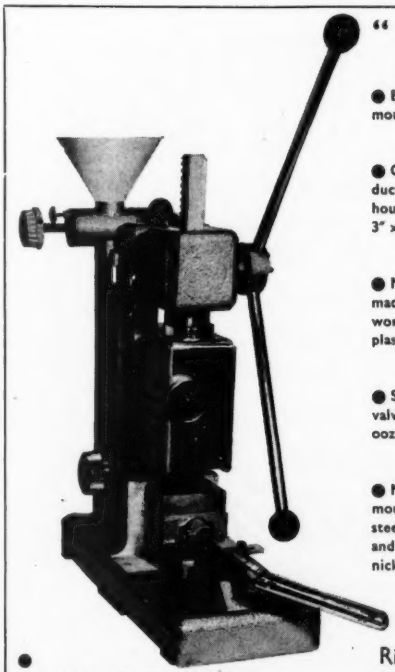

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- Most versatile machine suitable for working all thermoplastics including *nylon*.
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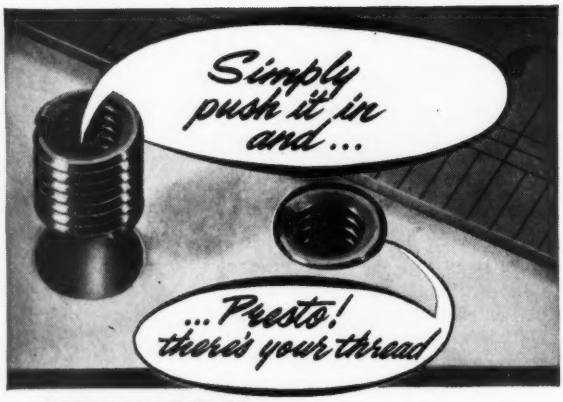

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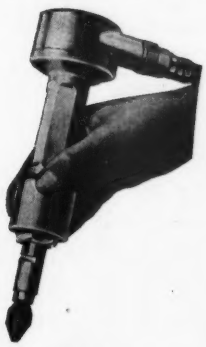

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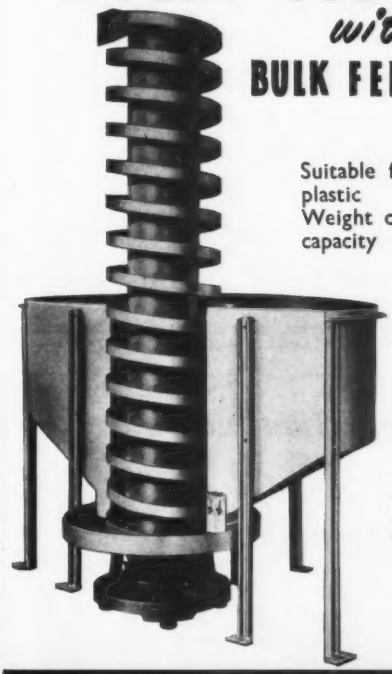

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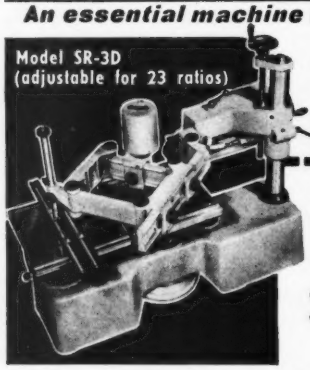

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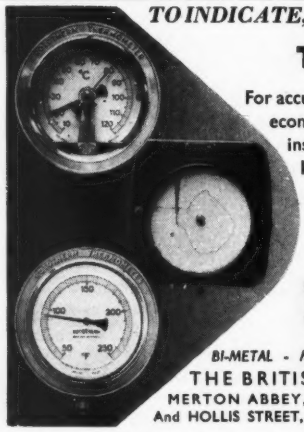

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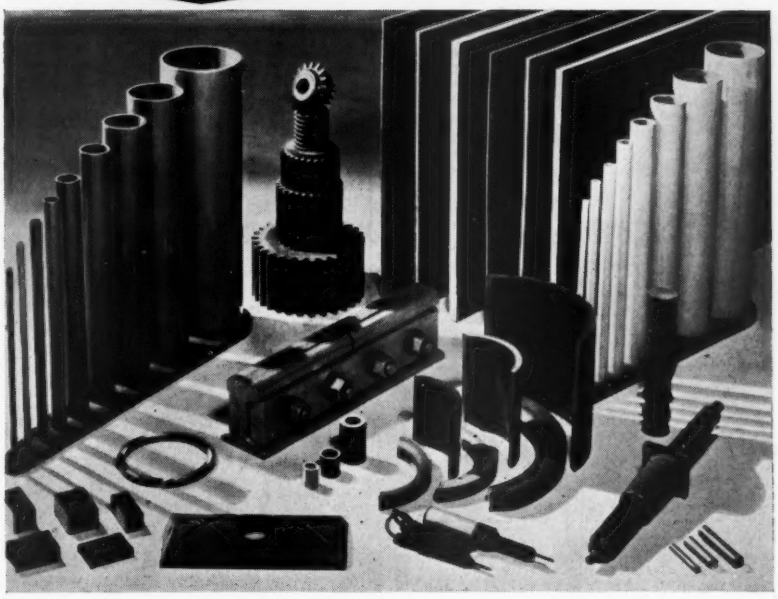

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PRESS DAY.—Classified advertisements for the October issue must be received at Head Office by first post Monday, September 24.

Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

RATES.—6d. per word (minimum 12 words 6/-). Each paragraph charged separately and name and address must be paid for. Semi-displayed setting 2 gns. per single column inch. Series discounts of 5% for 6, and 10% for 12 consecutive insertions allowed to trade advertisers.

TERMS.—Strictly net and prepayable. Monthly accounts for settlement by the end of the month following insertion are allowed to trade advertisers if satisfactory references are provided.

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THE PROPRIETORS retain the right to refuse or withdraw advertisements at their discretion and are not responsible for clerical or printers' errors although every care is taken to avoid mistakes.

BOX NUMBERS.—Private advertisers desiring to have replies sent care of "Plastics" may do so on payment of 1/- to cover booking and postage, plus cost of four extra words. To avoid mistakes in forwarding, Box numbers should be carefully and legibly copied and replies sent to Box P000, care of "Plastics," Bowling Green Lane, London, E.C.1.

DEPOSIT SYSTEM.—Facilities are available to readers to purchase advertised goods on approval by depositing the purchase price with "Plastics." Full details on application. Commission 1% (minimum 2/-) on amount deposited.

HEAD OFFICES.—Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus, London Telex," Telex: 2-3039.

BRANCH OFFICES: 7, John Bright Street, Birmingham, 1. Telephone: Midland 4117-8. 50, Hertford Street, Coventry. Telephone: Coventry 62464. 1, Brazennose Street, Manchester. Telephone: Deansgate 6114-8. 12, Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

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500-ton Downstroke Press by Greenwood & Batley, 18 in. dia. Ram × 28 in. stroke. Four Columns 6 in. dia. 22 in. × 17¾ in. between. Fully guided table, working area 31 in. × 22 in. Daylight 42 in. WP. 2 t. sq. in.

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Send your requirements to the specialists.
REED BROTHERS (ENGINEERING), LTD.,
REPLANT WORKS,
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NOTICES

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PATENTS

THE PROPRIETORS of British Patent No. 698,838 for " Method of and Apparatus for the Drying Treatment of Sludgy and Pasty Products in a Stage Drier " are desirous of securing commercial exploitation of the invention in the United Kingdom by way of licences or otherwise. Inquiries should be addressed to Stanley, Popplewell, Francis & Ross, 19, Buckingham St., Strand, London, W.C.2. 228-15

THE PROPRIETOR of Patent No. 691444 for Machines for Feeding, Working and Mixing Plastic Material, desires to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake & Co., 28 Southampton Buildings, Chancery Lane, London, W.C.2. 228-17

PRODUCTION CAPACITY AVAILABLE

INJECTION MOULDINGS by I.O.G. Industries, Ltd., 41 Marshgate Lane, Stratford, E.15. Maryland 2804. 232-1182

Production Capacity Available (contd.)

CAPACITY AVAILABLE for manufacturing compression and injection moulds, together with jigs and general engineering to customers' own designs, or alternatively, designed by us. Inquiries for same will receive prompt attention. Elloid Engineering Co., Ltd., Goodacre St., Mansfield, Notts. Phone, Mansfield 2614. zzz-299

ELCO PLASTICS, LTD.,
HIGH WYCOMBE,
BUCKS.
A.I.D.-APPROVED.
MOULDERS, INJECTION COMPRESSION,
TRANSFER, SIDE RAM.
HIGH WYCOMBE 1921-2. zzz-311

REPETITION in Ebonite, Erinoid, etc. Capstan lathe work. Temple St., Rugby. Phone 4059. 235-1208

SHORT RUNS A SPECIALITY, LONG RUNS A PLEASURE. Low mould cost and overheads. Injection capacity and technical knowledge at your service. Westminster Plastics, Temple Works, 41 Old Church Rd., Chingford, E.4. Silverthorn 7927. 235-1207

INJECTION MOULDINGS AND PLASTIC COVERING IN ACETATE ALKATHENE, P.V.C. POLYSTYRENE AND DIAKON.
Machined Parts in Brass, Steel and Plastics.
We solicit your inquiries.
F. A. KETCH AND SON, LTD.,
TRENT VALLEY WORKS,
LICHFIELD, STAFFS.
Phone 3591 and 3592. zzz-500

CHIPPING OF PLASTICS AND GRINDING, screening, mixing and drying of all raw materials undertaken for the trade. Crack Pulverizing Mills, Ltd., Plantation House, London, E.C.3. Man 4405. zzz-0302

PLASTICS lenses and reflectors moulded to any specification. Hand and power machines. Tools are available for a wide range of high precision components and complete end products. Howell Jones, 11/14 Cheapside Industrial Estate, Bridgend, Glamorgan. Phone: Bridgend 942. 228-XA252

PLASTICS (MANCHESTER), LTD.,
BRITAIN'S LEADING STOCKISTS AND DISTRIBUTORS.
SPECIALISTS IN
FABRICATION, INJECTION MOULDING AND ENGRAVING.
11 WHITWORTH STREET,
MANCHESTER, 1.
Central 7081-2 and Central 1000. zzz-308

INJECTION MOULDING CAPACITY available. Our speciality is the production of very small articles in polystyrene.
A. E. Stokes, rear of 128 Capworth St., Leyton, London, E.10. Leytonstone 3707. 229-1210

PINNACLE PLASTICS, LTD., have immediate capacity available for all types of injection moulding. Write 31 Guildford St., Luton. Phone 1010. 228-1193

TUBE LAMINATION AND ENGINEERING, LTD.,
HIGH WYCOMBE,
BUCKS.
MAKERS OF S.R.B.P. TUBE " LAMTUF."
LIGHT ENGINEERS.
HIGH WYCOMBE 1921-2 zzz-312

DINES PRODUCTS, Whitehall Lane, Grays, Essex, for injection mouldings. 235-1209

VACUUM FORMED PLASTICS. Facilities for design development, fabricating and printing. B. T. Bennett & Co., 449 Alexandra Avenue, Harrow, Middx. Field End 6755. 236-1219

Production Capacity Available (contd.)

KINGSTON PLASTICS, LTD., Unity Works, Union St., Kingston-on-Thames. Manufacturers of virgin and second-grade cellulose acetate moulding powders, matched to customers own requirements for colour and flow. Customers own waste also reprocessed to specified requirements. Sorting and grinding, incorporating magnetic separation of metallic particles of all thermoplastics undertaken. Phone, Kingston 8405. 231-1222

INJECTION MOULDING on hand and power machines. Die-sinking and engraving, immediate capacity. Howell Jones, 11/14 Cheapside Industrial Estate, Bridgend, Glamorgan. Phone: Bridgend 942. 228-XB252

VISIJAR LABORATORIES, LTD.
THE LEADING CRAFTSMEN IN " PERSPEX."
PROTOTYPE AND REPETITION.
OFFICIAL I.C.I. STOCKISTS " PERSPEX."
SHEET, TUBE, ROD.
STOCKISTS AND FABRICATORS OF " FORMICA."
149 LONDON ROAD, CROYDON, SURREY.
Phone, Croydon 8228 (two lines) zzz-307

COMPRESSION MOULDING. Works near London have immediate capacity available. A.I.D. approved. All enquiries will receive prompt and careful attention. Would also consider arrangements with reliable person, having established connection, who could introduce suitable work. Box P267, care of " Plastics." 231-1225

MANCHESTER FACTORY
PRODUCING ARTICLES FROM PLASTIC AND P.V.C. SHEETING
HAS CAPACITY AVAILABLE
FROM
TWENTY OF THE NEWEST TYPE
HIGH FREQUENCY ELECTRONIC WELDERS
LONG RUNS REQUIRED.
Would consider providing additional space and expanding facilities for business proposition. Apply in confidence: Box P2712, care of " Plastics." 227-17

PRINTING—SILK SCREEN. On P.V.C., Foam, Perspex a.s.o. Small or large runs. Close co-operation for speedy production.
Davis (Patents), Ltd., 18 Phipp St., London, E.C.2. Phone, BIShopsgate 2939 and 5091. 227-4

POLYSTYRENE AND CELLULOSE ACETATE INJECTION MOULDINGS up to 2 oz. Reliable service. Latest-type machines. Keen co-operation on new lines. W. H. Adamson Plastics, Ltd., 39 Hedley St., Maidstone. 232-5126

WRAITHE BROTHERS
PERSPEX
FABRICATION AND MOULDINGS TO SPECIFICATION.
PROJECTED APPLICATIONS DEVELOPED.
PROTOTYPE AND REPETITIVE RUNS.
Nuttall St. and Velvet St., Blackburn, Lancashire.
Blakewater 42363. 228-5120

IRISH COMPANY has capacity for extrusion, injection moulding and vacuum forming. Low production costs. Inquiries to Technical Director, Box No. 401, Granthams Advertising, Reading. 228-19

" KELLER " DIE-SINKING
CAPACITY AVAILABLE WITH
REASONABLE DELIVERY.
UNIVERSAL TOOLS LTD.,
TRAMWAY PATH, MITCHAM, SURREY.
Phone, MITcham 6111-2. 226-9

CAPACITY AVAILABLE for colouring and extrusion of polythene. Low rates. Box P2818, care of " Plastics." 228-35

Production Capacity Available (contd.)

6/8 OZ. INJECTION MOULDING CAPACITY immediately available, polystyrene, cellulose acetate, etc. General Woodworkers Ltd., Penn, Bucks. Penn 2215. 230-5142

INJECTION MOULDING Capacity 160 oz. cellulose acetate available. 800 sq. in. projected area. Write Box P2812, care of " Plastics." 228-25

PRINTING—SILK SCREEN. On P.V.C., Foam, Perspex a.s.o. Small or large runs. Close co-operation for speedy production.
Davis (Patents), Ltd., 18 Phipp St., London, E.C.2. Phone, BIShopsgate 2939 and 5091. 227-4

PRODUCTION CAPACITY WANTED

PROGRESSIVE MANUFACTURERS seek further injection moulding capacity up to 8 oz. continuous work throughout the year, essential for assembly to be undertaken. Full details to Box P2416, care of " Plastics." 227-20

RAW MATERIAL

WE SUPPLY polyethylene, polystyrene, scraps and reprocessed film waste, vinyl resins, all kinds of chemicals. Inquiries solicited. N. V. N. Jacobson and Co., 20 Hacquartstraat, Amsterdam. 229-1211

ALWAYS LARGE STOCKS OF
CASEIN
RODS, TUBES AND SHEETS.
PERSPEX
SHEETS UP TO 1 IN. THICK.
CELLULOSE ACETATE
CATALIN RODS.
S.R. (PLASTICS), LTD.,
93 ALDERSGATE STREET, E.C.1.
Phone, Monarch 4686. 233-1189

OPT. ACETATE WASTE, opaque and transparent, regular quantities. Box P2611, care of " Plastics." 228-x6606

FOR SALE. P.V.C. synthetic resin for long playing records. Apply Box P289, care of " Plastics." 228-21

AVAILABLE, 20 tons black polythene granules. Reasonable offer accepted. Box P1935, care of " Plastics." 228-49

LARGE QUANTITY of printed polythene film available. Please contact Box P1936, care of " Plastics." 228-50

PLASTICS (MANCHESTER), LIMITED,
BRITAIN'S LEADING STOCKISTS
OF
PERSPEX SHEET, ROD, TUBE,
11 WHITWORTH STREET,
MANCHESTER, 1.
Central 7081-2 and 1000. zzz-309

CUEX, LTD., can offer all at prices well below current list:—
Polystyrene.
Cellulose acetate.
Polyethylene.
P.V.C.
Polyvinyl butyral.
Perspex and Diakon.
Send now for details.
Cuex, Ltd., 270 Corporation St., Birmingham. Central 5474. 228-47

FOR DISPOSAL: 5 tons Brand New Ebonite and Casein Tubes and Rods, sizes .2 up to .6 diameter. Various colours. Apply Box P2614, care of " Plastics." 228-45

FOR DISPOSAL: 2 tons Virgin Khaki and 3 tons Virgin Maroon Polystyrene Pellets. Apply Box P2613, care of " Plastics." 228-46

FAVOURABLE OPPORTUNITY. Have available for sale approximately 5 tons P.B.C. resin, second quality, suitable for manufacturer of floor covering, etc. Box P2825, care of " Plastics." 228-60

RAW MATERIAL WANTED

ERLANOS, LTD., 93 Aldersgate St., E.C. (Monarch 4686), require Perspex and cellulose offcuts and scrap, clear and coloured; highest prices paid. 229-1159

WANTED, Polythene scrap. Write to Box P221, care of " Plastics." zzz-322

DO YOU HAVE ANY PLASTIC SCRAP TO SELL? Or are you looking for some to buy? Then contact Michael St. Stevens, Ltd., Keswick Rd., S.W.15. Phone, Vandyke 3345-6. zzz-303

PROMPT CASH OFFERED for virgin and reprocessed cellulose acetate and polystyrene. Give manufacturer's name and backing. Box P873, care of " Plastics." zzz-306

P.V.C. GARMENT AND HANDBAG OFFCUTS wanted. We collect and pay cash. Brockwell Plastics, Ltd., 50 Hollingbourne Rd., S.E.24. zz-305

SURPLUS STOCKS of thermosetting and thermoplastic moulding powders wanted. Send details. Box P1727, care of " Plastics." zzz-297

WANTED, large regular supplies of nylon scrap shaving. Hugh Kershaw, Oxenhope, Keighley. 232-5127

CELLULOSE ACETATE BUTYRAT scraps granulated virgin required cif Genoa. Offers with samples Joseph Meiohas, 68 Largo Orbassano, Torino (Italy). 229-5145

POLYTHENE, natural, large quantities required for export and home, injection and film scrap. Please offer with particulars and samples to Herbert Connor Ltd., 120 Beaufort Park, London, N.W.11. 228-53

DIAKON ACRYLIC SCRAP. We buy large and small quantities and pay prompt cash. Send your offers immediately to J. W. Nash and Co., Ltd., 27 Beethoven St., W.10. 228-48

WISHING TO BUY 3–4 tons cellulose acetate, reground, shell and clear. Offers with samples invited. Box P2824, care of " Plastics." 228-59

WISHING TO BUY 12 tons P.B.C. Cable slipping. Clean, free from metal and impurities. Light colours. Please accompany quotations with samples. Box P2823, care of " Plastics." 228-58

SITUATIONS VACANT

DESIGNER-DRAUGHTSMAN required, must have experience of compression, injection and transfer mould tools. Permanent and progressive position with small firm 30 miles from London. Golden opportunity for one with the necessary qualifications. Send full details of experience and salary required. Box P2623, care of " Plastics." 231-1231

PRODUCTION TECHNICIAN (EXTRUSION)

One of the oldest firms in this field wishes to recruit staff, to meet the expanding demand.

An all round experience on the practical side is required, with knowledge of development methods, and the ability to control labour.

This is a first-class opportunity for ambitious men, good salary, pleasant surroundings, and assistance with housing if necessary. Apply in confidence to the Works Manager. Box P2828, care of " Plastics." 228-63

B.X. PLASTICS, LTD., Brantham Works, near Manningtree, Essex, require a Chemist to take charge of a Control Laboratory covering the production of Nitrocellulose. Experience in cellulose chemistry would be very helpful, but is not necessary. Applications stating age, qualifications and experience, should be addressed to the Personnel Manager, B.X. Plastics, Ltd., Brantham Works, near Manningtree, Essex. 228-5119

TECHNICAL REPRESENTATIVE is required by the Chemical Division of B.X. Plastics, Ltd., to initiate a sales development programme on a new project. A degree in chemistry is essential and sales experience, particularly in the paint trade, desirable. The successful candidate will be based at Brantham and will be expected to travel widely in the United Kingdom. Applications stating age, qualifications and experience, should be sent to The Personnel Manager, B.X. Plastics, Ltd., Brantham Works, near Manningtree, Essex. 228-5121

GENERAL MANAGER required P.V.C. and Polythene factory London area, capable taking complete charge. Good salary, excellent prospects. Assistance in house purchase if necessary. Apply full details Box P2729, care of " Plastics." 228-5133

Situations Vacant (contd.)

VINYL PRODUCTS LTD. require for their P.V.C. laboratories young men of Inter B.Sc., or equivalent, for development work on P.V.C. compounds and pastes. Previous suitable experience on P.V.C. will be considered in lieu of qualifications. The appointments, which are in an expanding department, are progressive and pensionable. Successful applicants will be given facilities for part-time study. A vacancy also exists for a young man with previous laboratory experience, not necessarily on P.V.C. Applications in writing in first instance to Vinyl Products Ltd., Butter Hill, Carshalton, Surrey. 228-5132

British Belting & Asbestos Limited have the following vacancies in their Research Laboratory:
BRAKE LINING RESEARCH AND DEVELOPMENT

1. Graduate, or equivalent, in chemistry or plastics technology. N.S. completed.
2. Assistant. Previous experience in chemistry or plastics technology desirable. N.S. completed.

Both the above are progressive positions and encouragement will be given for further studies.

Applications should be made to Personnel Department, Scandinavia Mills, Cleckheaton, Yorkshire. 228-1

TOOLMAKER REQUIRED. First-class man with initiative. Capable of making and developing new machinery in connection with P.V.C. production. Very interesting work. Good salary for right man. Write or call V. & E. Plastics Ltd., 8 Gt. King St., Macclesfield. 228-3

A FIRST-CLASS SALES EXECUTIVE, with proved selling ability is required by a rapidly growing company manufacturing speciality chemical products for the plastics industry. The company is part of a larger group, and is extending its distribution throughout Europe. The Sales Organization is backed by full manufacturing potential and unrivalled technical service. Interested applicants should state their age, qualifications and proof of selling ability in reply to Box P2811, care of " Plastics." 228-24

ASSISTANT TO DEVELOPMENT DIRECTOR

Applicants must have good knowledge and experience of plastic products, calendering and spreading techniques. Knowledge of costing and estimating an advantage. Position may necessitate travelling in United Kingdom and abroad. Knowledge of foreign language will be of advantage. Age limit 40 years.

Please write in confidence, giving age, details of education, experience and qualifications to Box No. A.965, c/o Central News Ltd., 43 London Wall, London, E.C.2. 228-4

SALESMAN required to represent well-known plastic raw material manufacturers in the Northern half of the country. Knowledge of the injection moulding industry and in particular previous sales experience are essential. This is an excellent chance to fill a pensionable staff position in an expanding sales organization. State experience and salary required to Box P288, care of " Plastics." 228-22

ASSISTANT MANAGER for Plastics Sheet forming department (Perspex, Polystyrene; latest vacuum and pressure techniques). Wonderful opportunity for experienced man to develop recently formed department of old-established Company. Box P287, care of " Plastics." 228-23

GENERAL MANAGER

required by large Industrial Group with interests in the United Kingdom and abroad.

Here is the opportunity of a lifetime for a man of strong personality, possessing initiative and a detailed knowledge of the Plastice Extrusion Industry. Applicants should have held similar or senior Administrative positions previously.

Pension scheme, housing accommodation provided if necessary, salary commensurate with experience.

Applications in confidence, giving age, education, experience, salaries earned and salary required to Box No. A.962, c/o Central News Ltd., 43 London Wall, London, E.C.2. 228-5

WELL-ESTABLISHED and progressive company, with works situated in South Yorkshire, invite applications for the position of Technician in rapidly expanding Plastics Department. Experience in injection moulding and/or extrusion essential. The successful applicant will be required to work closely with the Design Department on the development of production techniques and methods. The position carries a good salary, is permanent, superannuated and offers good prospects for advancement. Reply giving full details to Box P2810, care of " Plastics." 228-20

FOREMAN for night work to take charge of Injection Moulding Machine Plant. Good salary to right applicant. Apply Box P285, care of " Plastics." 228-x9409

CHARGEHAND SETTER. Experienced man to take charge of moulding shop required. Box P2813, care of " Plastics." 228-26

Situations Vacant (contd.)

FOREMAN for assembly shop required by plastic moulders North London. Must be good disciplinarian and well versed in the use of plastic cements and solvents in addition to mechanical assemblies, etc. Apply Box P2814, care of " Plastics." 228-28

EXPERIMENTAL OFFICER
required by
the **ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, Berks.**

Duties will include an advisory service in the plastics and adhesives field and development work with new materials. Candidates should possess a minimum qualification of H.N.C. or equivalent in Chemistry although a pass degree or A.R.I.C. is preferred. They should be at least 26 years of age and should have a good fundamental knowledge of the high polymers together with practical experience of thermo plastic and thermosetting resins.

SALARY: £940–£1,155 p.a.

Contributory Superannuation scheme. Married officers now living outside the Establishment's transport area will be eligible for housing on one of the Authority's estates; alternatively assistance towards legal expenses incurred in house purchase may be available; until housed a lodging allowance may be payable.

Requests for application forms by POSTCARD to the Senior Recruitment Officer at the above address. Please quote reference A.11291/44. 228-7

A TECHNICAL SALES REPRESENTATIVE is required by Ashdowns Limited, leading Plastics Manufacturers, whose works is situated in St. Helens. The position is that of representative for Scotland and the north-east of England, and the person appointed will be required to take up residence in Scotland. Applications are invited from men between 30 and 40 years of age, who have sound technical background in mechanical and electrical engineering, who are capable of reading technical drawings, who have a wide connection throughout the appropriate industries in the area, and possess the initiative, drive and capability of working on their own responsibility. Experience in industrial plastics is an advantage but is not essential. Applicants are invited to send details of their education, preferably of matriculation standard, and experience to the Personnel Liaison Officer, Pilkington Brothers Limited, St. Helens, Lancs. (of whom Ashdowns Limited is a Subsidiary Company), quoting:—Ref. S. 228-8

MANAGER REQUIRED for Plastic Tubing for Domestic, Industrial and Agricultural uses; capable of organizing areas in the United Kingdom, appointing and dealing with Agents; preferably with knowledge and experience of plumbing and the various problems involved in this field. Good salary offered. Box A.937, c/o Central News Ltd., 43 London Wall, London, E.C.2. 228-16

BRITISH MOULDED PLASTICS LTD.,

will shortly be opening a new factory at Swindon, and require a GENERAL MANAGER who will be fully responsible for production, development, sales and accounting functions. The factory is a modern one and will be equipped with up-to-date plant including die-making plant and will eventually employ approximately 300 persons. The successful candidate should have many years' experience of the plastics industry and proven ability in a managerial position. A high salary will be offered commensurate with responsibilities.

Please apply, in full confidence, giving details of past experience to

MR. H. P. BRIDGE, MANAGING DIRECTOR,
BRITISH MOULDED PLASTICS LTD.,
AVENUE WORKS, WALTHAMSTOW, E.4.
228-13

GLASSFIBRE MOULDINGS. Foreman required, fully experienced in hand lay up moulding reinforced plastics. To take complete charge of works in Ireland Excellent opportunity for keen practical man with organizing ability. Assistance with housing. Box P262, care of " Plastics." 228-37

A VERY SUBSTANTIAL COMPANY engaged in Moulded Plastics (compression, injection, extrusion, etc.), and having a large and fully equipped Tool Room, requires:—

(*a*) A Chief Mould Designer and Estimator, preferably with many years' experience in a similar responsible position and

(*b*) A Chief Estimator for mouldings of all kinds, with similar long experience in the Industry. Time and motion study experience would be an advantage.

Only those who rank themselves as exceptional and amongst the very best in the Industry need apply for these positions, which carry exceptionally high salaries.

Please apply in full confidence, giving details of past experience, to Box P2821, care of " Plastics." 228-55

PRODUCTION MANAGER required with experience in the processing of thermoplastics such as P.V.C. and Polythene. Apply giving particulars of technical education and works experience to The Managing Director, Stanley Smith & Co., Worple Rd., Isleworth, Middlesex. 228-39

Situations Vacant (contd.)

WE are looking for a young man about 30–35 years of age for an appointment in a large North of England manufacturing company. The terms of reference will be to keep abreast with the vast and rapid development which is taking place in this country and abroad in plastic materials and in methods of fabrication, particularly extrusion and injection mouldings, and to assist in their application to day-by-day manufacturing. Applicants will therefore be required to have a sound knowledge of chemistry preferably to B.Sc. or A.R.I.C. standard and to have had good experience in the plastics industry. The appointment will be a senior one within the company with corresponding conditions. Assistance with housing will be given if necessary. Applications giving full details of career, qualifications and present salary, marked Confidential (Plastics) to: Box P2829, care of " Plastics." 228-65

PLASTICS TECHNICAL REPRESENTATIVE

Energetic young man who has had some experience of moulding or plastics fabrication would find wide scope in a remunerative post centred in London with rapidly expanding Co. marketing a range of special resins and moulding materials. Please write in full confidence to:

TECHNICAL DIRECTOR,

Box P2819, care of " Plastics."

228-56

VACUUM FORMING.
Representative required calling on industrial users. Apply Box P2612, care of " Plastics." 225-38

ASSISTANT TO DEVELOPMENT DIRECTOR
Applicants must have good knowledge and experience of plastic products, calendering and spreading techniques. Knowledge of costing and estimating an advantage. Position may necessitate travelling in United Kingdom and abroad. Knowledge of foreign language will be of advantage. Age limit 40 years.

Please write in confidence giving age, full details of education, experience and qualifications to the Managing Director, The Marley Tile Co., Ltd., Riverhead, Sevenoaks, Kent. Only applicants selected for interview will be notified. 228-44

PAINT OR RESIN CHEMIST

Experienced man, not necessarily fully qualified, wanted to take charge of Works and Technical Service Laboratory of small Resin Co. High salary rate and excellent prospects in a rapidly expanding Co. situated in a pleassnt country district. Please state full details of experience in strict confidence to:

TECHNICAL DIRECTOR,

Box P2820, care of " Plastics."

228-57

EXPERIENCED REPRESENTATIVE wanted to promote sales of Vacuum Formed articles. Apply The General Celluloid Co. Ltd., 206, Hanworth Rd., Hounslow, Middlesex. 228-43

AN EXPERIENCED MAN required, capable of taking charge of a small compression moulding shop. Within 40 miles of London. Well-paid and permanent position. Write stating full details of experience. Box P2220, care of " Plastics." 228-42

SALES MANAGER required by B.X. Plastics Ltd., for P.V.C. Calendered Sheet and related products. Experience of sales and general management essential. Practical knowledge of thermoplastics or textiles an advantage. This is an important position with good prospects for the right man. Applicants are invited to send details of education, experience, etc., to the Sales Director, B.X. Plastics Ltd., Chingford, London, E.4. 228-40

SITUATIONS WANTED

SALESMAN requires post as Sales Manager or Assistant. Over 16 years' experience plastics industry, including works experience estimating, internal sales, three years outside technical sales representative. Box P283, care of " Plastics." 228-x9981

Situations Wanted (contd.)

AN EXPERIENCED REPRESENTATIVE seeks appointment with capable trade moulder. Well connected buyers injection and compression London and S.E. England. Fully technical all aspects moulding and tooling. Could handle also sales reinforced mouldings, sheet forming, extrusions. Box P2817, care of " Plastics." 228-36

PLASTICS TECHNOLOGIST, Englishman stranded in Australia requires situation preferably in the South of England. Considerable experience in p.v.c. extrusion compounding, testing and formulating. Willing to sign five-year contract in return for assistance in returning to United Kingdom. Box P282, care of " Plastics." 228-x9310

MOULDMAKERS REQUIRED. Highest rates of pay for really good men. Chudleigh, Heathman's Yard, Parsons Green, S.W.6. Renown 1370. 228-32

DRAUGHTSMAN aged 27, seeks position in D.O. London area. Five years on mould work, detail and some design, mainly injection. Box P284, care of " Plastics." 228-x9980

YOUNG MAN, 27, well educated, some technical qualifications, desires progressive post in field of polythene development. Small company with " go-ahead " outlook preferred. Box P2816, care of " Plastics." 228-x29

INJECTION FOREMAN, fully experienced with latest technique tool setting, also modern production methods. Distance no object if accommodation provided. Box P2832, care of " Plastics." 228-155

WORKS' MANAGER, 20 years' plastic experience, aged 44, available now. Go anywhere in Britain. Would try sales. R. Craig, 92 Oakley Road, Luton, Beds. 228-X253

TIME RECORDERS

FACTORY TIME RECORDERS. Service rental. Phone, Hop 2239. Time Recorder Supply and Maintenance Co., Ltd., 157–158 Borough High St., S.E.1. 233-1190

TUITION

MIDDLESEX COUNTY COUNCIL
Education Committee
ACTON TECHNICAL COLLEGE,
High Street, Acton, W.3.

Applications are invited for a RESEARCH STUDENTSHIP in PLASTICS TECHNOLOGY, value £300 per annum for two years.

The successful candidate will be required to undertake research on a suitable project to be approved by the Trustees of the Plastics Industry Education Fund, and in addition may be required to give some assistance as a Demonstrator in Plastics Technology or allied subject.

Forms of application and further particulars may be obtained on application to the Principal, to whom completed applications must be returned within 14 days of the appearance of this advertisement.

C. E. Gurr, M.Sc., Ph.D.,
Secretary to the Education Committee.

BOOKS AND PUBLICATIONS

MOULDS FOR PLASTICS, by W. M. Halliday. Meets the needs of both mould designer and toolmaker. Discusses design, construction, operation and maintenance problems in the light of practical experience. Illustrated. 286 pages, 30s. net from booksellers, or 30s. 10d. by post from the publishers, Temple Press, Ltd., Bowling Green Lane, London, E.C.1. zzz

PLASTICS, SCIENTIFIC AND TECHNOLOGICAL (3rd Edition), by H. R. Fleck. A recognized standard work on the chemistry and technology of plastics. Illustrated. 400 pages, 40s. net from booksellers, or 41s. 3d. by post from the publishers, Temple Press, Ltd., Bowling Green Lane, London, E.C.1. zzz

CELLULOSE ACETATE PLASTICS, by Vivian Stannett. A complete technical survey of one of the most popular and adaptable products of the plastics industry. Illustrated, 284 pages, 30s. net from booksellers or 31s. by post from the publishers, Temple Press, Ltd., Bowling Green Lane, London, E.C.1. zzz

THE THEORY OF POLYMERIZATION, by H. R. Fleck. A full explanation in simple language with examples, calculations and exercises of this fundamental aspect of the chemistry of plastics. Illustrated, 144 pages, 10s. 6d. net from booksellers, or 11s. by post from the publishers, Temple Press, Ltd., Bowling Green Lane, London, E.C.1. zzz

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